Study Title: Efficacy of Eco-Friendly Toothpaste Tablets versus Conventional Toothpaste using PI and GI Index

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1. PROTOCOL INFORMATION

Study Title: Efficacy of Eco-Friendly Toothpaste Tablets versus Conventional Toothpaste using PI and GI Index
Funding Source: Loma Linda School of Dentistry
Investigation Product: Colgate "Cavity Protection" toothpaste and Colgate toothpaste tablets
IND / IDE number: N/A
Phase of Study: N/A
Version Date of Protocol: October 5, 2022

2. PRINCIPAL INVESTIGATOR'S INFORMATION

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3. STUDY PERSONNEL INFORMATION

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4. STUDY INFORMATION

Location(s) of Research Activity: Loma Linda School of Dentistry
Expected Start/Stop Dates of Research: 11/01/2022 to 08/30/2023
Special Time Sensitivities: N/A
Type of Research: *Minimal Risk*
Anticipated Enrollment number: 40
Patient Population: 40 subjects

5. OBJECTIVES AND PURPOSE

Due to its travel-friendly size and eco-friendliness, toothpaste tablets have gained popularity among the green people. Green people are those who aim to achieve sustainability. Despite toothpaste tablets' many merits, there is only scarce information on the efficacy, consumer satisfaction, cost, and benefits. Therefore, the purpose of our study is to evaluate the efficacy of toothpaste tablets when compared to conventional toothpaste in removing plaque. We aim to evaluate this by, measuring gingival index (GI) and the plaque index (PI) on subjects that have been either using the tabs or toothpaste.

We hypothesize that there will be no statistically significant difference in GI and PI scores between the two groups. The results of the study will be highly significant as it will serve as a strong piece of evidence to recommend or not to recommend this newly developed product that has the potential to keep our planet safe from non-degradable plastic.

6. STUDY DESIGN

Background Information & Rationale

Countless plastic toothpaste tubes are thrown out daily because conventional toothpaste is the prime tooth cleansing agent for millions around the world. Despite its ability to effectively tackle gum disease, malodor (bad breath), calculus, and dentin hypersensitivity, populations are not utilizing the whole tube as 10% still remains when discarded.[6,7] Therefore, plastic alternatives such as Colgate's Anywhere Toothpaste Tabs, DentTabs, Bite, and many other companies manufactured dissolving, chewable toothpaste in the form of small tablets. This favors sustainable consumerism at a slightly higher cost. Containing fewer ingredients than most toothpaste while packaged into reusable jars, toothpaste tablets' purpose forces individuals to be eco-friendly while still demonstrating excellent oral hygiene care. In addition, previous research has shown toothpaste tablets to have only a negligible dentin abrasion depth of 0.02mm compared to conventional toothpaste's 0.06mm loss.[2] Regardless of its non-abrasive component and versatile size, the last several years prompted questions regarding tablets' capability of plaque elimination.

Plaque accumulates on tooth surfaces due to the presence of biofilm. Biofilm consists of bacterial microorganisms that start as translucent, unstructured film that can eventually transition into calcified hard tenacious stones inside the oral cavity.[12] Due to its quick formation in a matter of 21 days, untouched biofilm left on tooth surfaces can ultimately lead to the development of dental caries and periodontal disease.

In order to show the effectiveness of plaque removal between conventional toothpaste versus toothpaste tablets, two highly recognized indices will be used: gingival index (GI) and Turesky's Modified plaque index (PI)–originally changed from Quigley Hein Index.

Gingival Index (GI) was introduced by Loe and Silness in 1963. GI can be used in all teeth or selected teeth. The examination will be done by a blunt probe. The following teeth will be used,

6	2	4	
	4	2	6

The GI scores will indicate as follows,

0: No inflammation.
1: Mild inflammation, slight change in color, slight edema, no bleeding on probing.
2: Moderate inflammation, moderate glazing, redness, bleeding on probing.
3: Severe inflammation, marked redness and hypertrophy, ulceration, tendency to spontaneous bleeding.

The GI index will be calculated as follows,

GI Index= GI total scores/No of surfaces (N=18)

GI Index Interpretation,

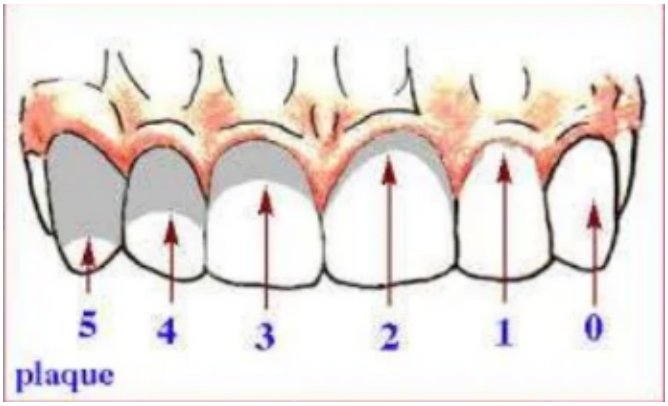
0.1–1.0: Mild gingivitis
1.1–2.0: Moderate gingivitis
2.1–3.0: Severe gingivitis

For measuring plaque accumulation, the Turesky Modified version contains a basis from 0-5, while also distinguishing severity and location. The same six teeth will be used.

The PI scores will indicate as follows,

0: No plaque.
1: Separate flecks of plaque at the cervical margin of the tooth.
2: A thin continuous band of plaque at the cervical margin of the tooth.
3: A band of plaque wider than 1 mm covering less than 1/3rd of the crown of the tooth.

4: Plaque covering at least 1/3rd but less than 2/3rd of the crown of the tooth.
5: Plaque covering 2/3rd or more of the crown of the tooth.



Given the environmental advantages of toothpaste tabs, it is worth exploring the effectiveness of tabs following the action of daily brushing within a 2-week trial period.

After measurements are recorded, comparison of the GI & PI results between tabs and conventional toothpaste will be assessed.

a. **Endpoints**

Primary endpoints
GI and PI scores between the use of dental tablets and conventional toothpaste.

Secondary endpoints
Satisfaction on user-friendliness of both types of toothpastes.

b. **Overall study design**

A convenience sample of 40 participants will be randomized into two groups containing 20 individuals each. Randomization will be performed by using a randomization table that is generated by the statistician. Selection of participants will concur to a written consent primarily based on voluntary agreement restricted only to a student consensus.
Group A. Colgate Cavity Protection will be selected as the conventional toothpaste for the control group due to its low abrasivity[8].
Group B. Colgate Anywhere Toothpaste Tablets will be used as the prime cleansing agent for the experimental group.

Subjects will be instructed to use their normal oral hygiene routine throughout a 2-week timeline. New toothbrushes will be used for both groups– Colgate Slim Soft Gliding Tips Toothbrush, Extra Soft, Compact Head.

Group B will be instructed to use Colgate Anywhere toothpaste tablets where one tablet will be used for brushing. Subjects will gently chew on the tablet to dissolve it and will brush for two minutes at least twice a day. Any residual excess from the tablets are to be spit out. Group A will use Colgate Cavity Protection toothpaste and brush at least twice a day for two minutes.

c. **Study Procedures and Schedule**

Subjects will consent to participate. The examiner will then perform an oral examination to provide an evaluation of plaque and gingival **indexes.** Post 2 weeks, a final assessment will be given by the same examiner done in the exact order and technique as the baseline test. The teeth will be reevaluated with new numeric data, where the scores will be added then divided by the total site surfaces. At the end participants will receive a 10-item satisfaction survey.

d. **Alternative procedures** → N/A

e. **Deception** → N/A

f. **Investigational New Drug (IND)** → N/A

7. INCLUSION / EXCLUSION CRITERIA

Inclusion criteria:

1. Subjects are 18 years or older;
2. Subjects who will comply with study protocol;
3. Subjects who can read and understand the consent form;
4. Subjects available during the study period;
5. Subjects have more than 20 teeth.

Exclusion criteria:

1. Subjects who are pregnant and/or nursing;
2. Subjects under the age of 18.

8. RECRUITMENT AND RETENTION

A flyer will be posted on LLUSD dental hygiene board. Please see attachment.

9. INFORMED CONSENT PROCESS

Informed consent will be obtained in accordance with the Declaration of Helsinki, ICH GCP, US Code of Federal Regulations for Protection of Human Subjects (21 CFR 50.25[a,b], CFR 50.27, and CFR Part 56, Subpart A), the Health Insurance Portability and Accountability Act (HIPAA, if applicable), and local regulations.

Prior to conducting any study-related activities, written informed consent and the Health Insurance Portability and Accountability Act (HIPAA) will be signed and dated by the subject.

The LLUSD East Wing Clinic will be used for the study. The reception desk will be used for student researchers to obtain the consent form from subjects that volunteer and are eligible.

10. SCREENING

On arrival at the reception desk, subjects will be screened for the listed inclusion and exclusion criteria.

11. POTENTIAL RISKS

There is minimal risk going through the clinical examination. However, there may be some jaw pain associated with prolonged mouth opening. Standard of care procedures for clinical oral examination will be followed under the supervision of a licensed dentist (including but not limited to proper PPE, infection control) and the process of assessment and survey will be explained during recruitment.

There is the possibility of a breach of confidentiality, this will be minimized by Subject data will be stored in a locked suite, locked office, and locked cabinet. Data stored electronically is only kept on secure LLU server.

12. POTENTIAL BENEFIT(S)

Potential benefits to subjects and society would be to provide that there is not a clinical or statistical difference in the efficacy of dental tablets versus conventional toothpaste. Providing data that presents no difference in using either tablets or toothpaste may incline the public to switch to an eco-friendlier dentifrice, thus reducing waste. Potential benefits outweigh the risks of this study due to the very low risk involved.

13. SUBJECT WITHDRAWAL OR TERMINATON

Reasons for withdrawal or termination: Subjects will have the freedom to withdraw at any time point of the study.

Handling of subject withdrawals or termination: Records will be kept on subjects that choose to withdraw and the reason why.

Premature termination or suspension of study: N/A

14. COMPENSATION

No compensation will be given to participants

15. CONFIDENTIALITY AND PRIVACY

There is the possibility of a breach of confidentiality, this will be minimized by Subject data will be stored in a locked suite, locked office, and locked cabinet. Data stored electronically is only kept on secure LLU server.

16. DATA COLLECTION AND MANAGEMENT RESPONSIBLITIES

Data Collection and Storage

- Data will be collected on the data collection sheet.
- Survey will be completed by the subjects on a hard copy.
- Data will be entered electronically onto an excel spreadsheet.
    - Paper records will be locked in a secure location
    - Electronic records will be stored on a password-protected or encrypted computer as appropriate based on the sensitivity of data.
- Consent forms will be stored in a locked suite, locked office, and locked cabinet.

- Data will not be transferred outside of LLUH.

Record Retention

1. Records of data/samples generated in the course of this study will be kept for at least 6 years and then destroyed. Prior to destruction, data can be used for other IRB approved research.

17. STATISTICAL ANALYSIS

We hypothesize that there will be no statistically significant difference in GI and PI scores between the two groups. To test this hypothesis, we will use an independent sample t-test to compare the difference in GI and PI scores between the two groups. If it is determined that GI and/or PI are not normally distributed, we will proceed with testing our hypothesis with the Mann-Whitney U-test. This hypothesis will be tested at an alpha level of 0.05 and will be two-sided. A sample size analysis was conducted and demonstrated that 20 samples per group were necessary to achieve 80% power to test this hypothesis at an alpha level of 0.05.

18. DATA AND SAFETY MONITORING PLAN (DSMP)

N/A

19. LITERATURE REFERENCES

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Schedule of Events

	VISIT 1 (Day/Week/Month)	VISIT 2 (Day/Week/Month)
Informed Consent	**X**	
Baseline Oral Examination (GI & PI)	**X**	
Distribution of Product	**X**	
Post 2-Week Oral Examination (GI & PI)		**X**
Survey Distribution		**X**
Weight		
Vital Signs		
Oximetry		
Spirometry		

RESULTS

Table 1. Summary of Gender and Age for Subjects Who Completed the Two-Week Clinical Study

	Number of Subjects			Age	
Dentifrice	Male	Female	Total	Mean	Range
Sodium Fluoride Toothpaste1	8	12	20	25	18-36
Sodium Fluoride Toothpaste Tablet2	6	14	20	25	19-30

Table 2. Summary of the Baseline Loe-Silness Gingival Index Scores and Quigley-Hein Plaque Index Scores

						95% Confidence Interval	
Parameter	Dentifrice	N	Baseline (Mean±SD)	Mean Difference	p-value	Lower	Upper
Gingivitis	Toothpaste Tablet	20	1.35±0.26	-0.08	0.47	-0.19	0.13
	Conventional Dentifrice	20	1.37±0.24				
Plaque	Toothpaste Tablet	20	2.80±0.58	0.06	0.665	-0.36	0.38
	Conventional Dentifrice	20	2.78±0.46				

Table 3. Summary of the two-week Loe-Silness Gingival Index Scores and Quigley-Hein Plaque Index Scores

						95% Confidence Interval	
Parameter	Dentifrice	N	Two-Week (Mean±SD)	Mean Difference	p-value	Lower	Upper
Gingivitis	Toothpaste Tablet	20	1.33±0.26	-0.06	0.37	-0.167	0.083
	Conventional Dentifrice	20	1.34±0.18				
Plaque	Toothpaste Tablet	20	2.59±0.49	0.08	0.579	-0.25	0.417
	Conventional Dentifrice	20	2.56±0.48				

Table 4. Summary of Within Group Analysis of Loe-Silness Gingival Index and Quigley-Hein Plaque Index Scores

						95% Confidence Interval	
Parameter	Dentifrice	N	Mean Difference	Percent Reduction	p-value	Lower	Upper
Gingivitis	Toothpaste Tablet	20	-0.026	1.9	0.765	-0.117	0.064
	Conventional Dentifrice	20	-0.011	0.8	0.936	-0.070	0.048
Plaque	Toothpaste Tablet	20	-0.224	8.0	0.017	-0.453	0.005
	Conventional Dentifrice	20	-0.218	7.8	0.035	-0.391	-0.045