

## Antiplaque Action of Chlorhexidine Gel and Coconut Oil in Children after Gum Massaging Therapy

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**Abstract:** Chemical plaque control measures like chlorhexidine reduces the caries risk for the patient by its antiplaque action but has several drawbacks. Scientific data has shown that oil pulling therapy can reduce plaque index. The aim of the study was to compare the efficacy of coconut oil and chlorhexidine gel as antiplaque agents when used for gum massaging in children. 80 children between the age group of 6-15 years were divided into 4 groups of 20 each. Agents used in the study were placebo gel, 1% chlorhexidine gel and commercially available edible coconut oil. Children in group 1, 2 and 3 were asked to massage their gums with the designated agent in the morning for a period of two minutes for three months except chlorhexidine gel (group 2) which was used only for 15 days. The fourth group of coconut oil had time duration of 4 minutes. The plaque score were assessed at baseline, 15<sup>th</sup>, 30<sup>th</sup>, 60<sup>th</sup> and 90<sup>th</sup> day. Chlorhexidine had a property of substantively as its antiplaque effect was seen after three months also. Coconut oil at the end of the study had a significant decrease in plaque scores. Between the coconut oil group and chlorhexidine group, oil groups showed lesser plaque scores than CHX group. Placebo group was least effective. Coconut oil can act as a substitute for 1% CHX gel when used for a prolonged period of time. Thus, it can be an effective plaque control tool.

**Keywords:** Coconut oil, Chlorhexidine gel, plaque scores.

### INTRODUCTION

Dental plaque can be defined as the diverse community of micro-organisms found on the tooth surface as a biofilm, embedded in an extracellular matrix of polymers of host and microbial origin [1]. The biofilms that colonize the tooth surface may be among the most complex biofilms that exist in nature. This complexity is due in large part to the non-shedding surface of the tooth, which permits persistent colonization and the opportunity for very complex ecosystems to develop [2]. Plaque accumulates preferentially at stagnant or retentive sites, unless removed by diligent oral hygiene. Environmental changes cause the equilibrium to get compromised and an imbalance appears among the indigenous bacteria resulting in pathologies like dental caries or periodontitis [3].

The most common method of oral hygiene maintenance is the mechanical methods of tooth

cleaning but adjuvants for decreasing plaque formation and maintaining oral hygiene have been sought. Presently chemotherapeutic agents are used as adjuvant agents to reduce plaque formation but they have their own disadvantages [4].

The signs of the carious demineralisation are seen on the hard dental tissues, but the disease process is initiated within the bacterial biofilm (dental plaque) that covers the tooth surface. Moreover, the very early changes in the enamel are not detected with traditional clinical and radiographic methods. If a cavity is allowed to develop, the site provides an ecological niche in which plaque organisms gradually adapt to a reduced pH. Formation of a cavitated lesion protects the biofilm, and unless the patient is able to cleanse this area, the carious process will continue [5].

Gum massage with any antibacterial agent including oil, can mechanically disrupt the biofilm on

the teeth and also stimulates the blood circulation to the gingival tissues [6-10].

Monolaurin, a monoester formed from lauric acid (medium chain fatty acids), found in abundance in coconut oil, has good antiviral and antibacterial activity [11]. Singla *et al.* reported study on the effect of 10 mins oil gum massage with various types of oil including coconut oil on the pathogenic oral microorganisms in comparison to chlorhexidine concluded that there was significant reduction in bacterial counts but to verify the role of mechanical disruption of biofilm during gum massage a control group was needed and a longer term follow up than 3 weeks [10] An in vivo study conducted in adults using coconut oil pulling, CHX and distilled water for a period of two weeks showed that there was a significant reduction in the *S. mutans* count in saliva with CHX and oil pulling [12]. Another study assessed the *S. mutans* count in plaque and saliva in children with coconut oil pulling and CHX for a period of one month. No significant difference was obtained between both the groups [13]. There's limited evidence of moderate quality existing, showing some likely benefits in the oro-dental health from the use of oil pulling, as compared to the usage of chlorhexidine mouthwash or placebo. If oil pulling can be proved to have beneficial effects, it could provide a low cost oral hygiene intervention [14].

Since there is a paucity of CHX and coconut oil gum massaging studies for a extended period of time, we have carried out this study with the aim to compare the efficacy of coconut oil and chlorhexidine gel as antiplaque agents in children. We have also used a placebo gel to rule out the possible effects of mechanical disruption of biofilm.

#### METHODOLOGY

Ethical clearance was obtained from the ethical committee of AB Shetty Memorial Institute of Dental Sciences and NITTE University. Informed consent was obtained from the concerned authorities. 80 children between the age group of 6- 15 years and DMFT plus def score of 3-5 were randomly divided into four groups of 20 each.

Group 1 consisted of placebo gel gum massaging for 2 mins for 90 days while Group 2 consisted of 1% CHX gel gum massaging for 2 mins for 2 weeks. Group 3 consisted of coconut oil gum massaging for 2 mins for 90 days while Group 4, also a coconut oil gum massaging group, used oil for 4 mins for 90 days. A commercially available edible coconut oil was used. For placebo gel, a HMPC (hydroxypropyl methylcellulose) preparation was used. Children who were caries free or with deep carious lesions, using any mouthwash, taken antibiotics in past 3-4 weeks, undergoing orthodontic treatment or medically compromised were excluded from the study.

Plaque scores were evaluated at baseline and at an interval of 15, 30, 60 and 90 days. Plaque scores were recorded using the plaque index given by Quigley Hein in 1962 and modified by Turesky S, Gilmore N D and Glickman (TGG-QH PI) in 1970. A mouth mirror and disclosing agent were used for recording the scores. No specific instructions were given to children for oral hygiene practice in order to eliminate any bias. They were then given group specific instructions regarding the usage of the agent. A similar procedure as described above for assessing the plaque score was carried out at an interval of 15, 30, 60 and 90 days. Statistical analysis was carried out for any changes in the plaque scores in all the groups.

#### STATISTICAL METHOD OF ANALYSIS

Descriptive and analytical statistics were done. The normality of data was analyzed by the Shapiro-Wilk test. As the data did not follow normal distribution the non-parametric tests were used to analyze the data. The Kruskal-Wallis test and Wilcoxon Signed Rank test was used to check differences in mean scores between groups wherever appropriate. Software: SPSS (Statistical Package for Social Sciences) Version 20.1 (IBM Corporation, Chicago, USA)

#### RESULTS

There was no statistically significant difference in the def/DMFT scores between the groups (Table 1).

**Table-1: Inter group comparison of DMFT scores at baseline**

| Groups  | N  | Mean | S.D. | Z-Value | P-Value* |
|---------|----|------|------|---------|----------|
| Group 1 | 20 | 4.00 | 0.79 | 5.101   | 0.165    |
| Group 2 | 20 | 3.40 | 0.88 |         |          |
| Group 3 | 18 | 3.77 | 0.87 |         |          |
| Group 4 | 20 | 3.80 | 0.83 |         |          |

\*P-value derived from Kruskal-Wallis Test

On intergroup comparison of TGG-QH PI scores at baseline, no statistically significant difference was seen. But a statistically significant decline in the TGGQH PI scores was seen between the groups on the 15<sup>th</sup>, 30<sup>th</sup>, 60<sup>th</sup> and 90<sup>th</sup> day.(Table 2) Coconut oil

massaging for 4 minutes was found to give the maximum reduction in the plaque score when compared to the 1%CHX gel and coconut oil massaging for 2 minutes but it was not statistically significant. Placebo gel was least effective (Table 3).

**Table-2: Inter group comparison of TGG-QH PI scores at baseline, 15 days, 1 month, 2 months and 3 months**

| Timeline | Groups  | N  | Mean | S.D. | Z-Value | P-Value*            |
|----------|---------|----|------|------|---------|---------------------|
| Baseline | Group 1 | 20 | 2.90 | 0.78 |         |                     |
|          | Group 2 | 20 | 2.95 | 0.88 | 2.017   | 0.569               |
|          | Group 3 | 18 | 2.94 | 0.80 |         |                     |
|          | Group 4 | 20 | 3.25 | 0.91 |         |                     |
| 15 Days  | Group 1 | 20 | 2.80 | 0.89 |         |                     |
|          | Group 2 | 20 | 1.00 | 0.00 | 44.470  | <0.001 <sup>†</sup> |
|          | Group 3 | 18 | 2.20 | 0.76 |         |                     |
|          | Group 4 | 20 | 1.50 | 0.51 |         |                     |
| 1 Month  | Group 1 | 20 | 2.85 | 0.74 |         |                     |
|          | Group 2 | 20 | 1.15 | 0.36 | 42.607  | <0.001 <sup>†</sup> |
|          | Group 3 | 18 | 2.45 | 0.94 |         |                     |
|          | Group 4 | 20 | 1.44 | 0.61 |         |                     |
| 2 Months | Group 1 | 20 | 2.90 | 0.78 |         |                     |
|          | Group 2 | 20 | 1.50 | 0.82 | 33.002  | <0.001 <sup>†</sup> |
|          | Group 3 | 18 | 1.75 | 0.78 |         |                     |
|          | Group 4 | 20 | 1.27 | 0.46 |         |                     |
| 3 Months | Group 1 | 20 | 2.65 | 0.81 |         |                     |
|          | Group 2 | 20 | 1.85 | 0.93 | 33.840  | <0.001 <sup>†</sup> |
|          | Group 3 | 18 | 1.35 | 0.58 |         |                     |
|          | Group 4 | 20 | 1.11 | 0.32 |         |                     |

\*P-value derived from Kruskal-Wallis Test; <sup>†</sup>significant at p < 0.05

**Table-3: Pair wise comparison of TGG-QH PI scores at baseline, 15 days, 1 month, 2 months and 3 months among the four groups**

| Timeline | Group 1 v/s Group 2 | Group 1 v/s Group 3 | Group 1 v/s Group 4 | Group 2 v/s Group 3 | Group 2 v/s Group 4 | Group 3 v/s Group 4 |
|----------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
|          | P-Value*            | P-Value*            | P-Value*            | P-Value*            | P-Value*            | P-Value*            |
| Baseline | -                   | -                   | -                   | -                   | -                   | -                   |
| 15 Days  | <0.001 <sup>†</sup> | <0.001 <sup>†</sup> | 0.660               | 0.215               | <0.001 <sup>†</sup> | 0.102               |
| 1 Month  | <0.001 <sup>†</sup> | <0.001 <sup>†</sup> | 1.000               | 1.000               | <0.001 <sup>†</sup> | 0.008               |
| 2 Months | <0.001 <sup>†</sup> | <0.001 <sup>†</sup> | 0.002 <sup>†</sup>  | 0.532               | 1.000               | 0.532               |
| 3 Months | 0.034 <sup>†</sup>  | <0.001 <sup>†</sup> | <0.001 <sup>†</sup> | 0.045 <sup>†</sup>  | 0.489               | 1.000               |

\*P-value derived from Dunn's post hoc Test; <sup>†</sup>significant at p < 0.05

A statistically significant reduction in the plaque score was seen after CHX gel use for 15 days. However, once the use of the gel discontinued a steady increase in the plaque score was seen over the next two and half months but were still lower than the baseline values. For group 3, a statistically significant reduction

in the plaque score was seen on the 15th day. Thereafter, there was a reduction in the mean scores which was not statistically significant. For group 4, a statistically significant reduction in plaque score was seen on the 15th day, from 1st to 2nd month and 2nd to 3rd month (Table 4).

Table-4: Intra group comparison of TGG-QH PI scores from baseline to 15 days, 15 days to 1 month, 1 month to 2 months and 2 months to 3 months

| Groups  | Timeline | N  | Mean | S.D. | Z-Value | P-Value*             |
|---------|----------|----|------|------|---------|----------------------|
| Group 1 | Baseline | 20 | 2.90 | 0.78 |         |                      |
|         | 15 Days  | 20 | 2.80 | 0.89 | -1.000  | 0.317 <sup>^</sup>   |
|         | 1 Month  | 20 | 2.85 | 0.74 | -0.577  | 0.564 <sup>#</sup>   |
|         | 2 Months | 20 | 2.90 | 0.78 | -1.000  | 0.317 <sup>^</sup>   |
|         | 3 Months | 20 | 2.65 | 0.81 | -1.667  | 0.096 <sup>^b</sup>  |
| Group 2 | Baseline | 20 | 2.95 | 0.88 |         |                      |
|         | 15 Days  | 20 | 1.00 | 0.00 | -3.972  | <0.001 <sup>^†</sup> |
|         | 1 Month  | 20 | 1.15 | 0.36 | -1.732  | 0.083 <sup>#</sup>   |
|         | 2 Months | 20 | 1.50 | 0.82 | -1.897  | 0.058 <sup>^†</sup>  |
|         | 3 Months | 20 | 1.85 | 0.93 | -1.364  | 0.172 <sup>^b</sup>  |
| Group 3 | Baseline | 18 | 2.94 | 0.80 |         |                      |
|         | 15 Days  | 18 | 2.20 | 0.76 | -3.839  | <0.001 <sup>^†</sup> |
|         | 1 Month  | 18 | 2.45 | 0.94 | -0.447  | 0.655 <sup>#</sup>   |
|         | 2 Months | 18 | 1.75 | 0.78 | -1.342  | 0.180 <sup>^</sup>   |
|         | 3 Months | 18 | 1.35 | 0.58 | -1.732  | 0.083 <sup>^b</sup>  |
| Group 4 | Baseline | 20 | 3.25 | 0.91 |         |                      |
|         | 15 Days  | 20 | 1.50 | 0.51 | -3.666  | <0.001 <sup>^†</sup> |
|         | 1 Month  | 20 | 1.44 | 0.61 | -1.127  | 0.260 <sup>#</sup>   |
|         | 2 Months | 20 | 1.27 | 0.46 | -3.071  | 0.002 <sup>^†</sup>  |
|         | 3 Months | 20 | 1.11 | 0.32 | -2.126  | 0.033 <sup>^b†</sup> |

\*P-value derived from Wilcoxon Signed Rank test; <sup>^</sup>significant at p < 0.05

<sup>^</sup>baseline to 15 days, <sup>#</sup>15 days to 1 month, <sup>^</sup>1 month to 2 months, <sup>^b</sup>2 months to 3 months

## DICUSSION

Dental caries in enamel is typically first seen as white spot lesions, which are small areas of subsurface demineralisation beneath the dental plaque. Dental caries is initially reversible and can be halted at any stage, even when some dentine or enamel is destroyed (cavitation), provided that enough biofilm can be removed [5]. Since, removal of plaque is facilitated by the use of mechanical or chemical means of removal we have evaluated the alterations in the plaque scores of the children.

In our study, the Plaque Index by Turesky et al was used because the Plaque Index by Silness and Loe has a major drawback of subjectivity in estimating plaque whereas the TGG-QH Index uses a disclosing agent with emphasis on the differences in accumulation in plaque in the gingival one third of the tooth [15-17].

In our study we have used 1% CHX gel for gum massaging using index finger for a period of two minutes because of patient compliance and several other reasons as follows. A recent review has stated that 1% CHX gel significantly inhibits plaque formation as compared to a 0.12% CHX dentifrice-gel or even a regular dentifrice and to be as effective as a 0.2% CHX mouthwash. It also states that pea sized amount of CHX gel when applied to the teeth and gums with their index

finger and left undisturbed for approximately 5 minutes before rinsing resulted in a significant improvement in gingival index and plaque scores (as evaluated in studies of 6–24 weeks) as compared to the placebo gel group [18]. A study comparing the effectiveness of twice-daily use of 0.2% chlorhexidine mouthwash, 1% gel and 1.4 ml of 0.2% chlorhexidine spray concluded that the mouthwash and spray were equivalent, whereas the gel was significantly better in preventing plaque and gingivitis in institutionalized children [19].

In our study however we have used oil massaging instead of oil pulling because of patient compliance. Oil pulling might be difficult to carry out for a child and require a high motivation level to do so. Gum massaging is easier to perform and more acceptable to the patient and also acts as an additional means of mechanical disruption of biofilm. Also, a study reported two cases of exogenous lipoid pneumonia in people who were practicing oil pulling for a long period of time as oil might get aspirated unintentionally [20].

The decline in the plaque scores with coconut oil was comparable to the chlorhexidine gel at the end of three months. This was in accordance to the studies done by Faizal C *et al.* who observed a significant reduction in the plaque index and gingival index 7th

day onwards after using coconut oil pulling for a period of 30 days [13]. This was also in accordance to another study conducted by Singla et al who reported a significant decrease in the plaque scores at the end of a 3 week study after a 10 minutes gum massage with various oils including coconut oil [10]. Substantively of CHX (after 2 minutes use for 15 days) causes reduction in plaque score even over a period of three months whereas continuous use of coconut oil (2 minutes and 4 minutes) over a span of three months also gave good plaque score reductions.

#### CONCLUSION AND RECOMMENDATIONS

Use of coconut oil is recommended for gum massaging on regular basis as an adjunct to tooth brushing to obtain its benefits. Considering the side effects of CHX as explained above, CHX gel usage should be kept to minimal and used only when other options are not feasible. Oil pulling therapy on the other hand has no disadvantages except for the long duration of the procedure when compared with chlorhexidine. But, according to our study, gum massaging with oil can help overcome these disadvantages of oil pulling.

#### FUTURE SCOPE

Future studies comparing the effectiveness of coconut oil with other oils on a long term basis are required. The taste and odour of coconut oil may not be acceptable to some and further studies using virgin coconut oil needs to be carried out.

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