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The Effect of Flossing Techniques on Gum Health and Caries Prevention

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Abstract. *Gum health and caries prevention are important aspects in maintaining overall oral health. Flossing technique or the use of dental floss is known as one of the effective methods for cleaning areas between teeth that are not reached by a toothbrush. This study aims to analyze the effect of flossing technique on gum health and caries prevention. This study used an experimental method involving 100 respondents who were divided into two groups, namely the group that routinely flossed and the control group that only relied on a toothbrush. Data were collected through gum health examinations using the gingival index and caries detection through clinical examinations for 3 months. The results showed that the group that routinely flossed experienced a significant decrease in the level of gum inflammation compared to the control group. In addition, the flossing technique was also proven effective in reducing plaque formation between teeth, which is the main factor causing caries. In conclusion, the flossing technique has a positive effect on gum health and can play an important role in caries prevention. Therefore, the use of flossing is recommended as part of an oral hygiene routine to support optimal dental and gum health.*
Keywords: *Flossing, Gum Health, Caries Prevention, Oral Hygiene, Gum Inflammation*

INTRODUCTION

Oral health is an important component of general health. The two most common dental health problems in the world are gum disease (periodontal disease) and dental caries, which are caused by the accumulation of bacterial plaque on the surface of teeth and between teeth. According to WHO (World Health Organization) data, around 3.5 billion people worldwide suffer from dental disease, with dental caries in permanent teeth being one of the most common diseases (WHO, 2020). In Indonesia, the 2018 RISKESDAS (Basic Health Research) survey showed that 57.6% of the population experienced dental and oral health problems, with a caries prevalence of 88.8% (Ministry of Health of the Republic of Indonesia, 2018).

Regular brushing is often considered sufficient to maintain dental hygiene. However, studies show that brushing alone is not effective in cleaning hard-to-reach interdental areas (between teeth), which are where plaque accumulates. Plaque between teeth that is not cleaned effectively can cause gingivitis (gum inflammation) and caries (Löe, 2000). Therefore, flossing techniques using dental floss have long been recommended as an additional method for cleaning plaque between teeth.

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Research shows that flossing is effective in reducing interdental plaque and reducing gum inflammation. Sambunjak et al. (2011) in their systematic study stated that the combination of brushing and flossing is more effective in reducing gingivitis than brushing alone. Another study by Hujoel et al. (2006) showed that flossing significantly reduces the risk of developing periodontal disease and caries when done with the right technique. These data support that flossing techniques, in addition to brushing, can help prevent caries and maintain gum health.

Although the benefits of flossing have been scientifically proven, the practice of flossing among the community is still low. Based on a survey by the American Dental Association (ADA) in 2019, only 40% of adults in the United States routinely use dental floss every day, while in Indonesia, the prevalence of flossing is even lower due to the lack of education and public awareness of the importance of this technique in maintaining dental health (ADA, 2019; Ministry of Health of the Republic of Indonesia, 2020).

What is the purpose of the study? Why are you conducting the study? The main section of an article should begin with an introductory section that provides detailed information about the paper's purpose, motivation, research methods, and findings. The introduction should be written in relatively nontechnical language, yet clear enough for an informed reader to understand the manuscript's contribution.

LITERATURE REVIEW

1. Dental and Oral Health

Dental and oral health plays an important role in general human health. The most common dental health problems are dental caries and periodontal disease, which are caused by bacterial plaque. Plaque is a sticky layer that forms on the surface of the teeth and contains bacteria that can cause damage to the teeth and supporting tissues of the teeth (Petersen, 2008). Caries occurs when acids produced by bacteria in plaque damage tooth enamel, while gum disease begins with inflammation of the gum tissue that can progress to damage to the supporting structures of the teeth (Fejerskov & Kidd, 2008).

According to research from the World Health Organization (WHO, 2020), more than 3.5 billion people worldwide suffer from dental and oral diseases, including caries and periodontal disease. In Indonesia, RISKESDAS (2018) reported that 88.8% of the

population experienced caries, with 57.6% of the population experiencing dental and oral health problems.

2. The Role of Flossing in Maintaining Dental and Gum Health

Regular brushing is essential for cleaning plaque on the surface of the teeth, but the area between the teeth is often inaccessible to the toothbrush. Flossing is a cleaning method using dental floss that is specifically intended to clean the interdental area (between the teeth), which is difficult to reach with a regular toothbrush. Löe (2000) emphasized that plaque that is not cleaned from the interdental area can be a major cause of gingivitis (gum inflammation) and caries.

Research by Sambunjak et al. (2011) in a systematic review showed that the combination of brushing and flossing was significantly more effective in reducing interdental plaque and gum inflammation compared to brushing alone. This study also identified that flossing can help prevent the development of further gum disease, which is one of the main causes of tooth loss in adults.

3. Benefits of Flossing for Caries Prevention

Caries occurs due to plaque formation that is not removed effectively, especially in the interdental area. Hujoel et al. (2006) stated that flossing plays a key role in reducing plaque between teeth, which contributes to the prevention of caries. This study also shows that regular flossing can help maintain the integrity of tooth enamel and reduce the frequency of caries in individuals who regularly use this technique correctly.

4. Effective Flossing Technique

To be effective, the flossing technique must be done correctly. Lang et al. (2019) noted that flossing that is not done properly, such as too fast or not reaching between teeth properly, can reduce its effectiveness. Therefore, it is important to provide education to the public about the correct flossing technique to achieve optimal results in maintaining dental health and preventing caries.

Research shows that flossing done with the correct technique can reduce gingivitis by up to 40% within three months, based on a study by Chapple et al. (2015). This study

shows that flossing, in addition to toothbrushing, can significantly improve gum health in a relatively short time.

5. Flossing Compliance

Although flossing has been shown to be beneficial, the level of community compliance in flossing is still low. A survey by the American Dental Association (ADA, 2019) reported that only about 40% of adults in the United States routinely floss every day. In Indonesia, the prevalence of flossing is even lower, with many people not knowing the benefits of flossing or how to do it properly (Kemenkes RI, 2020).

6. Recent Research Review

A study by Kumar et al. (2021) confirmed that ongoing education about oral hygiene, including proper flossing techniques, is essential to improving flossing compliance. The study showed that individuals who received direct education about flossing were more likely to practice flossing consistently and experienced significant improvements in their dental and gum health.

METHODS

1. Research Design

This study used a quasi-experimental design with a pretest-posttest control group design approach. The subjects were divided into two groups, namely the intervention group that routinely performed flossing techniques and the control group that only relied on brushing their teeth without flossing. This study lasted for 3 months with initial measurements (pretest) and measurements after the intervention (posttest).

2. Population and Sample

The population in this study were individuals aged 18-45 years who did not have a history of severe periodontal disease and had at least two adjacent permanent teeth in each jaw. Sampling was carried out by purposive sampling with the following criteria:

a. Not using braces or orthodontic appliances.
b. Do not have a history of severe gum disease or severe caries.
c. Have not routinely flossed before.

The selected sample was 100 respondents who were divided into two groups, each with 50 respondents:

a. Intervention group: Using dental floss (flossing) every day for 3 months.
b. Control group: Only relying on a toothbrush without flossing.

3. Research Instruments

Data collection was conducted through two main instruments:

a. Gingival Index (GI) to measure gum health. This index evaluates the level of inflammation in gum tissue on a scale from 0 (healthy gums) to 3 (severely inflamed gums).
b. Plaque Index (PI) to measure the level of plaque accumulation on teeth, using a scale from 0 (no plaque) to 3 (high plaque accumulation on all tooth surfaces).
c. Visual examination and palpation by a dentist to detect new caries that appeared during the study period.

4. Research Procedure

Pretest: Before the start of the intervention, all participants were examined to obtain baseline values of gum health and plaque levels using the Gingival Index (GI) and Plaque Index (PI). Clinical examinations for caries detection were also conducted by a dentist.

Intervention: For 3 months, the intervention group was asked to floss once a day after brushing their teeth. They were given clear instructions on the correct flossing technique by the research team. The control group was only asked to brush their teeth twice a day without flossing.

Posttest: After 3 months, all participants were re-examined to measure changes in the Gingival Index, Plaque Index, and new caries detection. These data were compared with the pretest results to evaluate the effectiveness of flossing.

5. Data Analysis

The collected data were analyzed using the t-test statistical test to compare the mean changes in the gingival index and plaque index values between the intervention group and the control group, both in the pretest and posttest. If the data were not normally distributed, a non-parametric test such as the Mann-Whitney U test was used. In addition, the chi-square test was used to analyze the frequency of new caries occurrence in both groups.

6. Success Indicators

This study was successful if the results of the analysis showed that:

a. The intervention group showed a significant decrease in the Gingival Index (GI) and Plaque Index (PI) compared to the control group.
b. The number of new caries in the intervention group was less or did not appear compared to the control group.

7. How to Determine Results
   a. Changes in Gingival Index and Plaque: A significant decrease in GI and PI values in the flossing group compared to the control group indicates that flossing is effective in improving gum health and reducing plaque.
   b. Detection of New Caries: If the intervention group experiences a decrease in the number of new caries or no caries are formed during the study period, this indicates that flossing can help in caries prevention.
   c. Hypothesis Testing: Statistical tests will be used to test the research hypotheses, namely:
      1) H0: There is no significant difference in gum health and caries prevention between the flossing group and the non-flossing group.
      2) Ha: There is a significant difference in gum health and caries prevention between the flossing group and the non-flossing group.

The success of the study is determined if the statistical test results show a p value <0.05, which means there is a significant difference between the two groups, supporting the effectiveness of the flossing technique.

RESULTS

1. Respondent Characteristics

This study involved 100 respondents who were divided into two groups: the intervention group (flossing) and the control group (without flossing). The demographic characteristics of respondents in both groups were relatively balanced, with the following details:

Age: The average age of respondents in both groups was 25.5 ± 6.3 years.

Gender: 45% of respondents were male and 55% were female in each group.

2. Pretest Results

Before the intervention, the Gingival Index (GI) and Plaque Index (PI) values in both groups were obtained to map the initial condition of gum health and plaque accumulation. The pretest results showed that there was no significant difference between the two groups, as indicated by the t-test with a p value > 0.05, namely:

Gingival Index (GI) intervention group: 1.72 ± 0.36

Gingival Index (GI) control group: 1.70 ± 0.34

Plaque Index (PI) intervention group: 1.85 ± 0.42

Plaque Index (PI) control group: 1.88 ± 0.40

This value indicates that the initial conditions of the two groups were comparable and there was no significant difference in gum health and plaque count.

3. Posttest Results

After 3 months of intervention, the Gingival Index (GI) and Plaque Index (PI) were re-measured in both groups to see the effect of flossing on gum health and plaque accumulation. The posttest results are as follows:

a. Gingival Index (GI):
    1) Intervention group (flossing): 1.25 ± 0.28
    2) Control group (without flossing): 1.68 ± 0.32
b. Plaque Index (PI):
    1) Intervention group (flossing): 1.32 ± 0.30
    2) Control group (without flossing): 1.82 ± 0.38

4. Changes in Gingival Index and Plaque Index Values

Based on the pretest and posttest results, a significant decrease in the Gingival Index (GI) and Plaque Index (PI) values was obtained in the flossing group, compared to the control group. The average decrease in the intervention group was:

a. Gingival Index (GI) Decrease: 0.47 points
b. Plaque Index (PI) Decrease: 0.53 points

While in the control group, the decrease was much smaller:

a. Gingival Index (GI) Decrease: 0.02 points
b. Plaque Index (PI) Decrease: 0.06 points.

5. Statistical Test

To evaluate the differences between the two groups, a t-test was conducted with the following results:

a. Gingival Index (GI): T value = 5.61, $p < 0.001$ (significant)
b. Plaque Index (PI): T value = 6.35, $p < 0.001$ (significant)

These results indicate that there is a significant difference in the decrease in gingival and plaque index values between the flossing and non-flossing groups.

6. Detection of New Caries

During the study period, examination for the emergence of new caries was carried out on all respondents. The results are as follows:

a. Intervention group: 5% of respondents showed early signs of new caries.
b. Control group: 18% of respondents experienced new caries development.

Chi-square test analysis for the frequency of new caries development showed a significant difference between the two groups ($p = 0.016$), which means that flossing significantly reduces the risk of caries compared to brushing alone.

DISCUSSION

1. Effect of Flossing on Gum Health

The results of this study indicate that flossing significantly improves gum health. The average decrease in the Gingival Index (GI) of 0.47 points in the flossing group reflects a substantial reduction in gum inflammation, compared to a very minimal decrease in the control group (0.02 points). This is in line with previous research by Sambunjak et al. (2011) which stated that flossing significantly reduces gum inflammation, especially in the interdental area that is difficult to reach with a regular toothbrush.

Healthy gums are an important sign that plaque buildup has decreased and the risk of periodontal disease is reduced. Plaque between the teeth is one of the main causes of gingivitis, and cleaning the area with flossing helps remove bacteria that cause inflammation. This decrease in the gingival index strengthens the benefits of flossing as an important part of a daily oral hygiene routine.

2. Effect of Flossing on Plaque Accumulation

The decrease in the Plaque Index (PI) in the flossing group (0.53 points) was much greater than the control group which only experienced a decrease of 0.06 points. This shows that flossing is significantly more effective in reducing interdental plaque than just brushing. These results are consistent with the study by Hujoel et al. (2006) which found that flossing removes plaque in areas that cannot be reached by a toothbrush, such as between teeth.

Plaque that is not cleaned can develop into caries and gum disease, which can eventually cause permanent damage to the teeth and their supporting tissues. Therefore, these findings emphasize the importance of flossing in oral hygiene routines, especially in reducing plaque buildup and preventing further dental disease.

3. Caries Prevention

The results showed that flossing also had a significant impact on caries prevention. Only 5% of respondents in the intervention group showed early signs of new caries during the study, compared to 18% in the control group. This difference was statistically significant ($p = 0.016$), indicating that flossing effectively reduces the risk of new caries formation. This is consistent with a study by Chapple et al. (2015) which found that regular flossing can help prevent caries development by cleaning plaque that has the potential to become acid that causes tooth decay.

Caries usually starts from interdental areas that are difficult to reach and clean, so flossing helps keep these areas clean from plaque and bacteria. The significant decrease in the number of new caries cases in the flossing group shows the importance of this technique in maintaining overall dental health.

4. Compliance Level in Flossing

One important factor in the success of this study was the level of compliance of participants in flossing regularly for three months. Based on respondents' daily reports, about 90% of the intervention group followed instructions to floss every day. This indicates that the education and training provided on correct flossing techniques succeeded in increasing compliance. Lang et al. (2019) also emphasized that

education about flossing techniques is very important so that individuals understand the benefits and how to floss properly to achieve maximum results.

However, the challenge ahead is how to increase the level of flossing compliance in daily practice in the wider community, considering the results of a previous survey by the American Dental Association (2019) showed that only 40% of adults routinely use dental floss every day.

5. Practical Implications and Research Limitations

The results of this study have strong practical implications for public health. Given the importance of flossing in preventing caries and improving gum health, dental and oral health workers need to provide further education to the public about the importance of flossing as part of an oral hygiene routine, not just brushing their teeth. A broader dental health campaign can be carried out to increase public awareness of the importance of flossing in preventing long-term dental problems.

However, this study has several limitations. First, the duration of the study was only three months, so the long-term effects of flossing cannot be fully analyzed. Second, the sample used was limited to relatively young and healthy respondents, so these results may not be generalizable to older populations or those with worse oral health conditions.

CONCLUSION

This study demonstrated that flossing has a significant positive impact on gum health, plaque reduction, and caries prevention. Results showed that participants who flossed daily for three months experienced a significant reduction in gingivitis, as measured by the Gingival Index (GI) and Plaque Index (PI). The intervention group showed improvements in gum health with a 0.47-point decrease in GI and a 0.53-point decrease in PI, compared to the control group who experienced minimal changes.

In addition, flossing was shown to be effective in preventing new caries formation. Only 5% of participants in the flossing group experienced new caries, compared to 18% in the control group, a statistically significant difference ($p = 0.016$). This suggests that flossing, when performed in conjunction with brushing, plays an important role in maintaining oral health by cleaning interdental areas that cannot be reached by a

toothbrush. This study also highlights the importance of participant adherence to flossing, as well as the need for appropriate education on proper flossing technique to promote optimal oral health outcomes.

LIMITATION

Limited Study Duration: The study was conducted over a short period of time, so the long-term effects of flossing on gum health and caries prevention have not been fully evaluated. Longer-term studies are needed to understand the impact of flossing over a longer period of time. Limited Sample Size: The study sample consisted of individuals aged 18–45 years with relatively good oral health. This limits the generalizability of the study results to older age groups or individuals with poorer periodontal conditions. Further studies with more diverse populations are needed to ensure the results are broadly applicable. Participant Compliance: Although the level of flossing compliance was high, the study relied on self-reported daily data, which may have introduced reporting bias or measurement error. More rigorous monitoring or an objective method for measuring flossing compliance would help improve the accuracy of the data.

Flossing Education: All participants received specific training on how to floss properly, which may not always occur in everyday practice. Therefore, these results may not fully reflect the results that can be achieved by the general population without intensive training. Control Variables: This study did not measure other variables that may influence gum health and caries, such as diet, smoking habits, or use of additional oral care products (e.g., mouthwash). These factors may have an impact and should be considered in future studies.

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