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ORIGINAL ARTICLE

EXPLORING THE GREEN ALTERNATIVE: A COMPARATIVE ANALYSIS OF MISWAK AND PLASTIC TOOTHBRUSH IN MAINTAINING GINGIVAL HEALTH

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ABSTRACT

Background: *Plastic toothbrushes have long been recognized as effective tools for maintaining oral and gingival health, but their use comes at the cost of environmental degradation. In contrast, Miswak, an organic alternative, not only promotes oral and gingival health but also provides environmental protection.*

Objectives: *To compare the effectiveness of Miswak, an environmentally friendly option, with plastic toothbrushes in maintaining gingival health.*

Method: *This cross-sectional comparative analysis was carried over a period of 6 months. A pre-validated questionnaire was circulated online and filled by sixty individuals who were divided into three groups with 20 participants each: Group A: Toothbrush users, Group B: Miswak users and Group C: Both. The questionnaire included questions pertaining to their gingival health status. The collected data was analyzed using SPSS. Chi-squared test was performed to compare the gingival health of participants.*

Results: *Results showed no significant difference in the gingival health status of all three groups, with a p-value of 0.898.*

Conclusion: *Toothbrush and miswak are equally effective in the maintenance of oral health. Thus, miswak can serve as an effective alternative to conventional toothbrushes with positive implications on the environment.*

Keywords: *Gingivitis, Oral Health, Environmental Impact, Dental Plaque, Oral hygiene, tooth brushing.*

This article may be cited as: Hassan S, Saqib W, Nazami A, Asim, AS, Mehmood F. Exploring the Green Alternative: A Comparative Analysis of Miswak and Plastic Toothbrush in maintaining Gingival Health. Pak Oral Dent J 2024; 44(1):51-56.

INTRODUCTION

Oral health diseases have been on a rise due to a shift in our dietary patterns i.e., increased consumption of refined sugars and processed starchy foods. Bacterial plaque is the chief cause of diseases in the oral cavity, which most commonly includes caries and gingivitis. Gingivitis on its own is reversible; however, if not treated, can lead to periodontitis.[1,2] Mechanical removal of plaque is therefore critical in preventing these conditions.[3]

Oral hygiene greatly influences an individual's general and systemic health and is therefore directly linked to the person's well-being. With rising oral health problems, the need for improved and readily available oral health maintenance devices has also increased.[4] The toothbrush is widely used mechanical aid for plaque removal worldwide. These conventional toothbrushes contain nylon bristles and plastic handles, making it non-biodegradable.[5] This plastic hence directly contributes to air pollution and resultant environmental degradation. Owing to its lower cost and easier manufacturing process, plastic has prevailed as a material of choice over the last couple of decades. However, the negative environmental effects are severe, since

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Received for Publication: Aug 11, 2023
Revised: Feb 12, 2024
Approved: Feb 14, 2024

the chemical structure of plastic makes it resistant to the natural process of degradation. Globally, 5 to 13 million tons of plastics — 1.5 to 4% of global plastics production — end up in the oceans every year.[6] It is estimated that plastic accounts for over 80 % of marine litter.[7] Although it may not be the major source of plastic pollution, toothbrushes are a contributing factor and are replaceable if an equally effective substitute can be provided.

The "green dentistry "approach is based on the model of four R's—Reduce, Reuse, Recycle and Rethink."[8] In order to practice green dentistry, there are several green alternatives that are marketed in the US, in Europe and in Australia such as wooden toothbrush with pig bristles, wooden toothbrush with nylon bristles, silicone-based toothbrushes and plastic handle toothbrushes with changeable bristles.

As oral and dental diseases increase globally, there is a growing interest in exploring safe, effective, and culture-specific traditional remedies alongside modern approaches.[9] In some parts of the world "chewing sticks - Miswak", a derivative of Arak tree, is conventionally being used as an alternative.[10] Muslims commonly employ miswak in oral hygiene practices due to its sacred religious background. Additional advantages of miswak consist of its sialagogue properties and regulation of peristaltic activity.[11]

When it comes to comparing effectiveness of miswak and toothbrush, literature provides contradictory reports. Several studies claim that chewing sticks are as effective in reducing plaque and gingivitis as a toothbrush.[1,2] Meanwhile other literature supports the claim that miswak users have a higher prevalence of gingivitis.[12,13] Plaque on the lingual surfaces of teeth cannot be easily removed by miswak as it has its bristles along the long axis,[14] whereas some reports conclude that toothbrush's efficacy in removing plaque from interproximal sites is not as beneficial as chewing sticks.[15] Research shows that miswak also affects the micro biota of oral cavity and it impedes the growth of various staphylococcus and streptococcus species.[16,17]

This study aims to comprehensively evaluate the comparative efficacy of Miswak, an eco-friendly alternative, in contrast to conventionally used toothbrushes, with regard to their impact on maintaining oral hygiene, gingival and periodontal health. Specifically, we seek to determine whether Miswak demonstrates equivalent effectiveness when compared to traditional toothbrushes.

This study aims to compare the effectiveness of Miswak, a traditional teeth-cleaning chewing stick, with a plastic toothbrush in maintaining oral and gingival health. The rationale of the study is to explore eco-friendly alternative to conventional tooth brushes, considering the environmental impact of plastic. By comparing both, the study aims to provide evidence of potential benefits or drawbacks of using Miswak as a green alternative for oral hygiene. The study's findings could facilitate a shift towards sustainable oral care practices, minimizing plastic waste and promoting environmentally conscious oral hygiene habits.

MATERIALS AND METHODS

The cross-sectional study was conducted over a period of 6 months. Ethical approval was obtained from the ethical committee, Islamic International Dental College, Riphah International University. The sample size was calculated using WHO calculator. 60 healthy subjects were recruited from across Pakistan, via the convenience sampling method. The subjects were divided into three groups, having 20 participants each, based on their mode of cleaning: Group A: Toothbrush users, Group B: Miswak users and Group C: those who used both toothbrush and miswak.

The inclusion criteria included all healthy individual with complete permanent dentition between 18-60 years of age. The exclusion criteria excluded participants who were systemically compromised, pregnant and lactating females, orthodontic patients, grossly carious, restored, or extremely maligned teeth and participants taking medications that cause gingival enlargements.

The rationale of the study was clearly explained to the participants. Participation was deemed voluntary and full confidentiality was maintained. A pre-validated questionnaire was circulated online and used as the research instrument to compare the gingival health of participants using either miswak, toothbrush or both. Any potential bias was minimized by randomizing question and answer options, limiting personal opinions and scale questions, and incorporating diversity and inclusion initiatives to enhance the overall fairness and equity of the study. The questionnaire compromised of 3 sections –demographics, oral hygiene practices and oral and gingival health status. The collected demographics included age, gender, education level, and estimated monthly incomes. Other sections included questions regarding participants' mode and frequency of cleaning, general awareness regarding oral hygiene, their oral hygiene perception, level of tooth decay, and frequency of bleeding, pain, redness and swelling.

Gathered information was then compiled and participants were classified into different stages of gingivitis based on their presence, duration and severity of bleeding, swelling, redness and pain.

The data collected were analyzed using SPSS version 21.0. Descriptive variables (gender and education) were documented as frequency and percent-

age. Numerical variables like age were expressed as mean ± SD. Chi-square test was used to compare the gingival health of miswak and toothbrush users. $P < 0.05$ was considered significant.

RESULT

A total of 72 subjects were assessed for eligibility: 8 were found ineligible and 4 of them refused to participate. Final study sample comprised of 60 subjects.

Participants included 36 females and 24 male participants. Majority of participants were among the age group of 18-30 (73.3%). Significant demographic details are summarized in Table 2.

Stages of gingivitis were compared between Group A, B and C groups using Chi-squared test. The results were statistically insignificant and a p- value of 0.898 was obtained. The results indicate that there was no difference in gingival health of toothbrush users, miswak users and those who used both.

The examination of subjects revealed, that 29 had no gingivitis, 23 had mild gingivitis, and 08 had moderate gingivitis. (Figure 2). A detailed analysis of stages of gingivitis among the three groups is given below.

Other variables included oral hygiene behaviors, among which 55% of subjects cleaned their teeth twice daily, 35% cleaned once daily, 6.7% cleaned three times a day or more, and 3.3% used cleaning devices weekly. Approximately 83.3% (50) of study participants used other oral hygiene devices, in addition to toothbrush and miswak, out of which 32 used mouth rinses, 16 used dental floss and 2 of them used interdental brushes.

DISCUSSION

This research aims to investigate alternative, environmentally friendly options to conventional toothbrushes, with a focus on their effectiveness in maintaining gingival health. The results of the study suggest that there is no significant difference in gingival health among individuals who use Miswak, toothbrushes, or a combination of both. This finding is particularly relevant in light of the growing environmental concerns associated with conventional plastic toothbrushes. These results are seconded by a Meta – analysis conducted by Ramli et al which concluded that Miswak effectively reduced plaque and gingivitis scores to a level comparable to toothbrush when used exclusively.[18]

Miswak, a natural teeth-cleaning twig obtained from Salvadora persica trees, has been utilized for centuries in various cultures. Its potential as a sustainable and effective oral hygiene tool is of increasing interest in today's eco-conscious society. However, existing literature presents contradictory results regarding

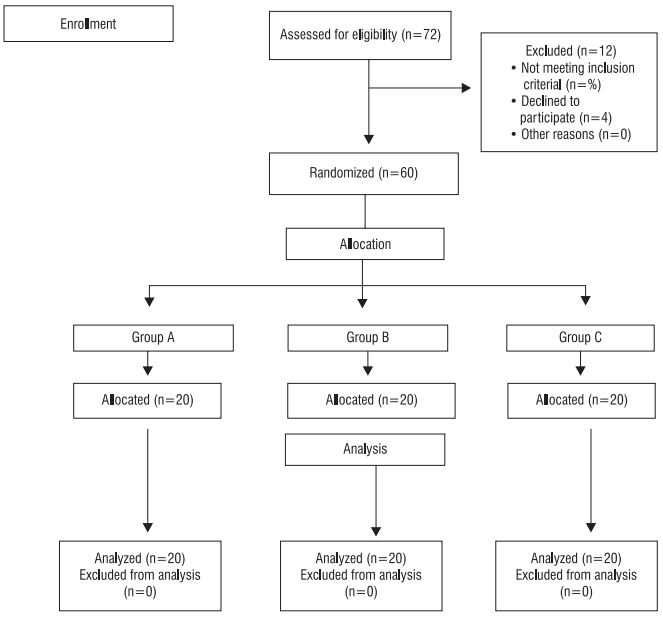

Fig 1: Flowchart showing design of current study

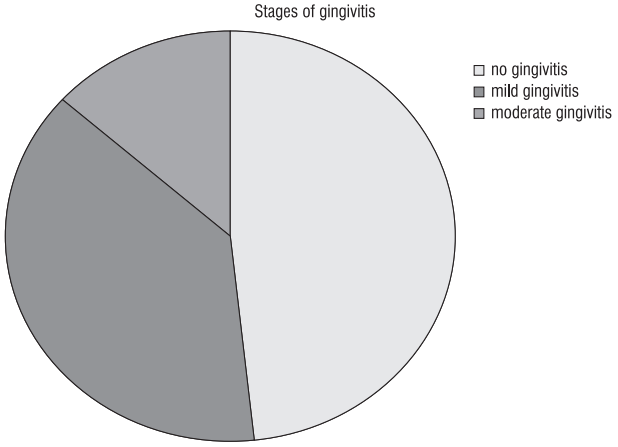

Fig 2: Showing relative prevalence of gingivitis among respondents.

effectiveness of Miswak in comparison to toothbrush in protecting gingival health. According to Hardie et al, miswak is more effective in reducing plaque and gingivitis due to various chemicals released by the miswak stick and the mechanical action of its fibers.[19]

Noha et al reported that when miswak is used as an adjunct to toothbrush a prominent reduction of plaque and gingivitis scores is seen.[20] While other researches reveal a higher prevalence of gingivitis among miswak users.[12,13] This may be attributed to the incorrect placement of miswak fibers which can cause a gingival recession.[21] According to Ramli et al miswak is a beneficial tool for removing plaque and improving periodontal health but incorrect placement of miswak fibers may lead to gingival recession and loss of attachment.[22]

TABLE 1: STAGES OF GINGIVITIS

	Initial lesion (no gingivitis)	Early lesion (mild gingivitis)	Established lesion (moderate gingivitis)	Advanced lesion (severe gingivitis)
Bleeding	No	Sometimes	Yes (moderate)	Yes (heavy)
Swelling	No	Sometimes	Yes	Yes
Redness	No	Sometimes	Yes	Yes
Pain	No	No	Yes	Yes

TABLE 2: DEMOGRAPHIC DETAIL OF PARTICIPANTS

Demographics	Frequency	Percentage
Age		
18-30	44	73.3
31-40	05	8.3
41-65	10	16.6
Gender		
Male	24	40
Female	36	60
Monthly income		
Above 10,000 PKR	21	35
10,000-50,000 PKR	15	25
Above 50,000 PKR	24	40
Level of education		
Primary level	02	3.3
Intermediate	07	11.7
Undergraduate or above	51	85

TABLE 3: ILLUSTRATES STAGES OF GINGIVITIS WITH REGARDS TO USE OF DIFFERENT ORAL HYGIENE MEASURES

			Group			Total
			A	B	C	
Stages of gingivitis	No gingivitis	Count	9	9	11	29
		% within Mode of cleaning	45.0%	45.0%	55.0%	48.3%
	Mild gingivitis	Count	8	9	6	23
		% within Mode of cleaning	40.0%	45.0%	30.0%	38.3%
	Moderate gingivitis	Count	3	2	3	8
		% within Mode of cleaning	15.0%	10.0%	15.0%	13.3%
Total	Count		20	20	20	60
	% within Mode of cleaning		100.0%	100.0%	100.0%	100.0%

Some studies state that Miswak has a beneficial effect on gingival health when used in combination with conventional toothbrushes. These contradictory results found in different literature may be attributed to a variety of influencing factors, for example socio-economic status, awareness level, incorrect use of toothbrush and/or miswak and different study population and designs.

As the results of present study indicate no difference in gingival health of individuals using either Miswak or toothbrush, plastic toothbrushes can easily be replaced by Miswak in households, reducing the environmental burden caused by plastic waste. In Pakistan, the widespread use of chewing sticks over toothbrushes is primarily driven by their easy availability, particularly among the rural population, which constitutes more than 50% of the country's inhabitants.[23,24]

Dentists recommend replacing toothbrush every 2 to 3 months, resulting in an estimated annual consumption of approximately 75 million toothbrushes in developing countries like Pakistan.[25] This consumption is significantly greater in developed parts of the world; US alone has annual consumption of above 1 billion.[26] Conventional toothbrushes, primarily made of non-renewable fossil fuel-derived materials, emit greenhouse gases during production, and their plastic handles pose recycling and biodegradability challenges that persist beyond a single generation.[26] While researchers globally explore biodegradable toothbrush alternatives, Miswak stands out. This natural tooth-cleaning twig offers cost savings, biodegradability, and antibacterial properties.[27] Derived from the Arak tree, Miswak has no negative environmental impact and grows resiliently worldwide, making it an easily accessible and eco-friendly choice.[28]

A notable aspect of this study is that it took subjects general oral health beliefs and level of tooth decay in oral cavity into consideration, which was not assessed in previous study by Aeeza et al.[24] The sample size was significantly large and included both male and female, in comparison to research carried out by Mohammed et al.[3] Our study also excluded subjects who may have an altered level of oral hygiene due to different factors such as orthodontic appliances, extremely malaligned teeth, systemic conditions and use of drugs causing gingival hyperplasia or other oral manifestations.

However, the present research study encountered some limitations. The effect of miswak and toothbrush was considered only on the general oral and gingival health. Certain studies reveal that miswak if used for an extended time duration may result in tooth discoloration and enamel abrasion.[29] Furthermore, the data was collected through an online platform, relying on subjects' self-assessment of their oral, gingival, and periodontal health. There were no resources to verify that whether the information filled was in line with subjects' actual oral health status. In addition, the population studied, majorly belonged to the highly urbanized city of Islamabad, Pakistan and its surrounding urban areas. Conducting the study in a rural setting might yield different results due to difference in socioeconomic status, lack of knowledge regarding oral health maintenance and limited resources for oral hygiene devices.

Hence, these shortcomings open vistas for further research studies. Further investigations could be conducted in a rural environment, potentially leading to significantly distinct outcomes. The study design could be expanded to evaluate additional factors such as enamel abrasion, tooth discoloration, and sensitivity among individuals using miswak. Clinically, participants could undergo assessment, receive instruction on the proper techniques for using both miswak and toothbrush, and subsequently be monitored over a designated period to record alterations in gingival health resulting from the utilization of miswak, toothbrush, or a combination of both.

CONCLUSION

The results of the present study can be of great importance in resolving the dilemma of Plastic toothbrushes. It also provides good means of switching to a more cost-effective substitute to toothbrush owing to Miswak's medicinal as well as economical features it would not only be a key step towards a more holistic approach in resolving oral health concerns of the population but also be a major contributor in practicing "Green Dentistry".

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