

Comparing the Efficacy of Plaque Removal between *Salvadora persica* (Miswak) and Manual Toothbrush in 12 to 15 Years School Children

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ABSTRACT

Aim: To compare the efficacy of plaque removal between chewing stick (Miswak—*Salvadora persica*) and manual toothbrush in 12 to 15 years old school children.

Methods: A randomized, examiner-blind, parallel design study was conducted over a 2-month period, among 12 to 15 years old students of Sri Sajjan Rao Vidya Samasthe, Bengaluru. A sample size of 60 subjects was randomly allocated into two groups, 30 subjects in group A (manual toothbrush) and 30 subjects in group B (chewing stick). The plaque index (Turesky et al, modified Quigley Hein plaque index) was used for base line, pre- and postintervention assessment. Then the data was collected and subjected to statistical analysis and the test used was Student-t test.

Results: The results were given separately for between and within group comparison. The difference in mean PI score between toothbrush users and tooth stick users is found to be statistically significant ($p < 0.01$). Higher mean PI score was found in tooth stick users compared to toothbrush users and the mean difference was statistically significant. The difference in mean PI score in both the groups, before and after intervention was statistically significant ($p < 0.001$).

Conclusion: Manual toothbrush and Miswak tooth sticks (*Salvadora persica*) both are effective in removal of plaque, but manual toothbrush was more effective than Miswak tooth stick, which was statistically significant.

Keywords: Oral hygiene, Miswak, Chewing stick, *Salvadora persica*, Manual toothbrush, Plaque removal.

INTRODUCTION

Health and diseases go together. Where there is life, diseases are bound to exist. Dependency and sustainability of man and animal life has been revolving around plants through their uses as food, fibers and shelter, but also plants have been used to control and ease diseases, therefore, the use of plants as medicines is an ancient and reliable practice, 3000 years before the birth of Christ. It is believed that this precursor to the modern day toothbrush was used in Europe until about 300 years ago.¹ Today, Miswak is being used in Africa, South America, Asia, the Middle East including Saudi Arabia and throughout the Islamic countries.^{2,3,8} Cure of diseases through medicinal plants is always a salient feature of Islamic teaching and preaching.

The toothbrush tree, *Salvadora persica*, locally called Miswak, is a member of the Salvadoraceae family and has been used by many Islamic communities as toothbrushes and scientifically proven to be very useful in the prevention of tooth decay, even when used without any other tooth cleaning methods.⁴ Studies indicate that *S. persica* extract is somewhat comparable to other oral disinfectants and antiplaque agents, such as triclosan and chlorhexidine gluconate, if used at a very high concentration. It has been reported that extracts of Miswak

posses various biological properties, including significant antibacterial, antifungal and anti plasmodial effects. *S. persica* and other related plants are reported to be effective against bacteria that are important for the development of dental plaque.^{4,5}

The World Health Organization (WHO) recommended and encouraged the use of the Miswak sticks as a tool for oral hygiene in 1986, and in 2000 an international consensus report recommended for further research to evaluate the effectiveness of chewing stick on oral hygiene.⁶

When properly used, Miswak has been reported to be as effective as toothbrush.⁵ The present study compared the effect of chewing stick (Miswak—*Salvadora persica*) and manual toothbrush on plaque removal in 12 to 15 years old school children.

MATERIALS AND METHODS

A randomized, double-blind, parallel design study was conducted over a 2-month period. The study was carried out among 12 to 15 years old students from Sri Sajjan Rao Vidya Samasthe School, Bengaluru. Permission was obtained from school and the study procedure was informed to the principal and the staff of the school. Informed consent was obtained from

the parents. There were around 111 school children of age group 12 to 15 years, among them the children who fulfilled the inclusion criteria were 96. Out of these 96 subjects, 60 students were included in the study through simple random sampling.⁷

Fresh 60 chewing stick (Miswak—*Salvadora persica*) with uniform diameter (5 mm) were cut into equal length (20 cm). And a total of 60 pieces of Colgate Zig-Zag plus™ manual soft-bristled toothbrushes were purchased from retailers (Figs 1 and 2).

The students (subjects) in the presence of their parents were requested to discontinue the use of oral hygiene aids during the study period. The subjects were instructed to use only the toothbrush and Miswak (*Salvadora persica*) provided to them by the investigator till the end of the study period.

A comprehensive case history and base line data was recorded, which includes demographic details, personal history, diet history, periodontal status, extrinsic and intrinsic stains, deposits, hard tissue examination (caries tooth, filled/restored tooth, pulp/periapical infection, and any other abnormality). Plaque index was assessed using the Turesky et al, modified Quigley Hein plaque index (base line data). All clinical examinations were carried out in natural light source, using plane

mouth mirrors and blunt probes. Plaque scores were assessed after disclosing the subjects' teeth with Alpha Plac, plaque disclosing agent (Ramen research products, Chennai). The disclosing solution was applied on the small cotton swab and then gently dabbed on the tooth surface. And the subjects were instructed not to rinse their mouth with water till the examination was completed. All the recordings were made on a plaque index proforma specially designed for this purpose.

The subjects were randomly assigned using the lottery method to one of the two treatment groups labeled as group A and group B with brushing assignments known only to the principal investigator and the subjects. Out of 60 subjects included in the study, both the groups received 30 subjects each.

A week before commencement of the study, each group received the instructions on the use of toothbrushes and chewing stick (Miswak—*Salvadora persica*) by the principal investigator separately in the absence of the examiner and subjects from other groups.

After the randomization of the subjects into different groups, three weeks before conducting study, the two groups assigned for using Miswak stick and manual toothbrush received their respective intervention with instructions on the usage as a part of the familiarization for duration of three weeks. The subjects were made to brush the teeth with the respective intervention under the supervision of the principal investigator for the familiarization, twice daily (in the morning at 8 am and in the evening at 5 pm). Individual patient was not informed about the study hypothesis and asked not to disclose to the examining dentist, which oral hygiene method they were using.

After 3 weeks, i.e. on 21st day, the subjects were informed not to brush the teeth for two days, i.e. on 22nd and 23rd day. Then on 24th day the study groups (subjects) were scored for plaque indices which gave us pretest and post-test data values (Fig. 3).

After the pretest data (plaque scores) collection, new manual toothbrush or chewing stick (Miswak—*Salvadora persica*) were given to the subjects and were instructed to use the assigned oral hygiene aid, either the chewing stick (Miswak—*Salvadora*



Fig. 1: Colgate Zig-zag plus™ manual soft brush



Fig. 2: Miswak (*Salvadora persica*) tooth sticks



Fig. 3: Study subjects brushing with Miswak (*Salvadora persica*) tooth sticks

persica) or the manual toothbrushes, in accordance with the brushing exercise randomizations done earlier, under the supervision of principal investigator (Fig. 3).

After using the respective oral hygiene aid, all the subjects returned for the final examination, i.e. post-test data collection was carried out by the same calibrated examiner who performed the pretest examination.

STATISTICAL ANALYSIS

Data analysis was performed by statistician who was blinded to the identity of the test products. SPSS software version was used for analysis purpose. Plaque index scores for whole mouth were expressed as means and standard deviations (SD). Both between group and within group comparison was made. Within each treatment group, the change from pretest to post-test was analyzed using a paired t-test and between groups it was analyzed using unpaired t-test. The mean changes from pretest to post-test in the two groups were compared using Student t-test which was termed as outcome analysis. All hypothesis tests were conducted at the two-sided $\alpha = 0.05$ level of significance.

Once the statistical analysis was completed, the groups were decoded for further analysis to determine and compare the efficacy of plaque removal using manual toothbrush and chewing stick (*Miswak—Salvadora persica*).

RESULTS

A randomized, double-blind, parallel study design was conducted over a 2-month period. An exploratory analysis of plaque score was used, which enumerated the findings related to the efficacy of plaque removal by these two new brushing

exercises. As presented in Table 1, there was no significant difference in the mean PI score between the two groups at baseline and before intervention ($p > 0.05$).

The difference in mean PI score between toothbrush users and tooth stick users is found to be statistically significant ($p < 0.01$). Higher mean PI score was found in toothstick users compared to toothbrush users and the mean difference was statistically significant.

In toothbrush users group, it was found that there was a significant difference between mean baseline PI scores and the mean PI scores before intervention ($p < 0.001$). The difference in mean PI scores between baseline and after intervention was also found to be statistically significant ($p < 0.001$). Also, the difference in mean PI score before and after intervention was found to be statistically significant ($p < 0.001$). Higher mean PI score was recorded before intervention followed by baseline and after intervention respectively. The difference in mean PI score between each time interval was found to be statistically significant, as given in Table 2.

And in tooth stick users group, there was a significant difference between mean baseline PI scores and the mean PI scores before intervention ($p < 0.001$). The difference in mean PI scores between baseline and after intervention was also found to be statistically significant ($p < 0.001$). Also, the difference in mean PI score before and after intervention was found to be statistically significant ($p < 0.001$). Higher mean PI score was recorded before intervention followed by baseline and after intervention respectively. The difference in mean PI score between each time interval was found to be statistically significant, as stated in Table 3.

Table 1: Comparison of PI score between the two groups

Time interval	Group	Mean	Std dev	Mean difference	t	p-value
Baseline	Toothbrush	1.91	0.52	-0.135	-0.926	0.358
	Tooth stick	2.04	0.61			
Before intervention	Toothbrush	3.99	0.43	0.045	0.433	0.667
	Tooth stick	3.94	0.37			
After intervention	Toothbrush	0.11	0.10	-0.107	-2.814	0.007*
	Tooth stick	0.22	0.19			

*significant difference

Table 2: Comparison of PI score at different time intervals in toothbrush users group

Time interval	Mean	Std dev	Mean differences	t	p-value
Baseline PI	1.91	0.52	-2.083	-19.597	< 0.001*
Before intervention PI	3.99	0.43			
Baseline PI	1.91	0.52	1.793	18.683	< 0.001*
After intervention PI	0.11	0.10			
Before intervention PI	3.99	0.43	3.876	47.855	< 0.001*
After intervention PI	0.11	0.10			

*significant difference

Table 3: Comparison of PI score at different time intervals in tooth stick users group

Time interval	Mean	Std dev	Mean differences	t	p-value
Baseline PI	2.04	0.61	-1.903	-14.392	< 0.001*
Before intervention PI	3.94	0.37			
Baseline PI	2.04	0.61	1.821	15.383	< 0.001*
After intervention PI	0.22	0.19			
Before intervention PI	3.94	0.37	3.724	45.124	< 0.001*
After intervention PI	0.22	0.19			

*significant difference

DISCUSSION

Miswak (*Salvadora persica*) is the most frequently used chewing stick. When properly used, Miswak has been reported to be as effective as toothbrush.^{5,9,10} The results disclosed a significant reduction in the plaque scores after the use of both manual toothbrush and Miswak tooth sticks. To standardize the experimental conduction, all participants/subjects were issued with identical conventional toothbrush (Colgate Zig-Zag plus™ toothbrush) and chewing sticks (approximately 15 cm long and 1 cm in diameter) of fairly uniform length and width and were instructed for the efficient use of both devices, similar to the study conducted by Mohammed Batwa et al in 2006.¹⁴ The clinical scoring were expressed in Turesky et al,¹² modified Quigley-Hein Plaque Index scores for both the groups in accordance to study by MJ Cronin.¹¹

The validity of the results is related to the applied methodology. The study design differentiated between the effects of each device in the controlled way, i.e. the participants were asked to refrain from using toothbrush or any other oral hygiene aids during the study period. And the subjects were instructed to use only the toothbrush or tooth sticks provided to them by the investigator till the end of the study period. And a week before the commencement of the study, the subjects were given instruction on how to use the manual toothbrush and Miswak tooth stick, demonstration were provided using models.

Results of the present study cannot be exactly compared with other studies as the study design and the age group of the subjects vary, however, observations can be made. For this comparative observation the overall mean outcome value for both plaque index and their p-values was used.

In the present study, the results disclosed that the difference in mean plaque index value was found to be statistically significant in between baseline, preintervention and postintervention levels. Miswak (*Salvadora persica*) and toothbrush both were found to be statistically significant in plaque removal with ($p < 0.001$). But toothbrush was more effective than Miswak tooth sticks.

The results revealed that in the present study higher mean PI score (0.22 ± 0.19) was found in tooth stick users compared to toothbrush (0.11 ± 0.10) users and the mean difference was statistically significant. Difference in mean PI score (0.11)

between toothbrush users and tooth stick users was found to be statistically significant ($p < 0.01$). The result was similar to the study done by V P Helderma et al (1992) with higher mean of PI score (21.16) was found in tooth stick users compared to toothbrush (19.64) users and the mean difference was not statistically significant. And was in contrast to the study done by Al-Otaibi et al (2003) with mean of PI score (14.67 ± 0.12) for Miswak (*Salvadora persica*) and (15.34 ± 0.16) for toothbrush.

The difference between mean PI score (0.22 ± 0.19) in tooth stick users and mean PI score (0.11 ± 0.10) in toothbrush users was statistically significant and was similar to the study done by Hamed Ahmed et al¹³ with mean of PI score (0.778 ± 0.495) for Miswak (*Salvadora persica*) and PI score (0.899 ± 0.431) for toothbrush, and the mean difference was statistically significant.

In the present study, higher mean PI score (0.22 ± 0.19) was found in tooth stick users compared to toothbrush (0.11 ± 0.10) users and the mean difference was statistically significant. This was in contrast to the study done by Mohammed Batwa et al¹⁵—higher mean PI score (6.4 ± 5.1) was found in toothbrush users compared to tooth stick PI score (5.9 ± 5.4) users and the mean difference was not statistically significant.

In the present study, results showed that manual toothbrush was more effective than Miswak tooth stick, i.e. higher mean PI score (0.22 ± 0.19) was found in tooth stick users compared to toothbrush (0.11 ± 0.10) users, which was in accordance to the Mengel et al.¹⁶ But some studies found that there was more plaque formation and gingival bleeding in individuals who used chewing sticks in comparison with toothbrush users.¹⁵⁻¹⁷

The plant fibers remove plaque and simultaneously massage the gum. The value of chewing sticks is believed to be in their mechanical cleansing action.¹⁸ However, the use of miswak has also been reported to inhibit the formation of dental plaque chemically, and exert antimicrobial effect against many oral bacteria.¹⁹ It has been demonstrated *in vitro* that aqueous extracts of miswak have growth inhibitory effects on several oral microorganisms.¹⁹⁻²¹ Chewing sticks also have fungistatic and antimycotic effects.²¹⁻²³

The numbers of participants were small in the study and a larger sample might have disclosed more significant differences

than found in the 30 subjects. Longitudinal and crossover studies can give better results, as they reveal the efficacy of plaque removal, analgesic, antimicrobial effects of miswak sticks.

CONCLUSION

In the present study, it was seen that manual toothbrush and Miswak tooth sticks (*Salvadora persica*) both were effective in removal of plaque, but manual toothbrush was more effective than Miswak tooth stick and was statistically significant.

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REFERENCES

1. http://en.wikipedia.org/wiki/Salvadora_persica/Retrieved August 12, 2009.
2. Hattab FN. Miswak: The natural toothbrush. *Journal of Clinical Dentistry* 1997;8(5):125-29.
3. Darout IA, Astrom AN, Skaug N. Knowledge and behavior related to oral health among secondary school students in Khartoum Province, Sudan. *Int Dent J* 2005;55(4):224-30.
4. KM Nadkarni. *Indian plants and drugs with their medical properties and uses* (1st ed). 2005;348.
5. M Al-Otaibi, Mohammed Al-Harthy, Birgitta Soder, Anders Gustafsson, Birgit Angmar-Mansson. Comparative effect of chewing sticks and toothbrushing on plaque and gingival health. *Oral Health and Preventive Dentistry* 2005;4:301-07.
6. WHO/FDI, Consensus statement on oral hygiene. *Int Dent J* 2000;50:139.
7. American Dental Association on Scientific affairs. "Acceptance Program Guidelines for Toothbrushes", 1998; http://www.ada.org/prof/resources/positions/standards/Guide_toothbrushed.pdf, Retrieved September 25, 2007.
8. Olsson B. Efficiency of traditional chewing sticks in oral hygiene programs among Ethiopian school children. *Community Dent Oral Epidemiol* 2005;6:105-09.
9. Gazi M, Saini T, Ashri N, Lambourne A. Miswak chewing stick versus conventional toothbrush as an oral hygiene aid. *Clin Preventive Dent* 1990;12:19-23.
10. Aderinokun GA, Lawoyin JO, Onyeaso CO. Effect of two common Nigerian chewing sticks on gingival health and oral hygiene. *Odonto-Stomatologie Tropicale* 1999.
11. MJ Cronin, WZ Dembling, MA Cugini, MC Thompson, PR Warren. Three-month assessment of safety and efficacy of two electric toothbrushes. *J of Dent* 2005;33(Suppl 1):23-28.
12. Turesky S, Gilmore ND, Glickman I. Reduced plaque formation by the chloromethyl analogue of vitamin C. *J Periodontol* 1970;41:41-43.
13. Van Palenstein Helderma WH, Munck L, Mushendwa S, Mrema FG. Cleaning effectiveness of chewing sticks among Tanzanian school children. *J Clin Periodontol* 1992;19:460-63.
14. Mohammed Batwa, Jan Bergström, Sarah Batwa, Meshari F Al-Otaibi. The effectiveness of chewing stick miswak on plaque removal. *Saudi Dental Journal* 2006;18(3):125-33.
15. Mengel R, Eigenbrodt M, Schunemann T, Flores-de-Jacoby L. Periodontal status of a subject sample of Yemen. *J Clin Periodontol* 1996;23:437-43.
16. Norton MR, Addy M. Chewing sticks versus toothbrushes in West Africa. *Clin Preventive Dent* 1989;11:11-13.
17. Eid M, Sellim HA, al-Shammery AR. The relationship between chewing sticks (miswak) and periodontal health (Part 1). *Quintessence Int* 1990;21:913-17.
18. Akhtar MS, Ajmal M. Significance of chewing sticks (miswak) in oral hygiene from a pharmacological view point. *J Pak Med Assoc* 1981;31:89-95.
19. Al-Lafi T, Ababneh H. The effect of the extract of the Miswak (Chewing stick) used in Jordan and the Middle East on oral bacteria. *Int Dent J* 1995;45:218-22.
20. Homer KA, Manji F, Beighton D. Inhibition of peptidase and glycosidase activities of *Porphyromonas gingivalis*, *Bacteroides intermedius* and *Treponema denticola* by plant extracts. *J Clin Periodontol* 1992;19:305-10.
21. Almas K, Al-Bagieh NH. The antimicrobial effects of bark and pulp extracts of miswak (*Salvadora persica*). *Biomedical Letters* 1999;60:71-75.
22. Lewis WH. Plants used as chewing sticks. *J Prev Dent* 1980;6:71-73.
23. Mohammad Yaheya, Mohammad Ismail, Nagwa M Assem, Mohammad Zakriya. Botanicals promoting oral and dental hygiene: A Review. *RJPBCS* April-June 2010;1(2):202-06.