Miswak (*Salvadora Persica*) As an Alternative Oral Aid to Reduce Denture Induce Stomatitis on Edentulous Patients

Nusima Mohamed[1]*, Norlela Yacob[2], Wan Nor Syariza Wan Ali[3], Aida Ali[4], Nor Azlina Ismail[5], Nasadila Nadhira Nasseri[5]

1. Department of Restorative and Prosthodontics, Faculty of Dentistry Universiti Sains Islam Malaysia.
2. Department of Restorative and Prosthodontics, Faculty of Dentistry Universiti Sains Islam Malaysia.
3. Department of Restorative and Prosthodontics, Faculty of Dentistry Universiti Sains Islam Malaysia.
4. Department of Restorative and Prosthodontics, Faculty of Dentistry Universiti Sains Islam Malaysia.
5. Department of Restorative and Prosthodontics, Faculty of Dentistry Universiti Sains Islam Malaysia.

Abstract

Miswak (Salvadora Persica) has been used widely as oral aid since Babylonians era. Many methods have been introduced to improve the patient's denture hygiene but few researches on methods for cleaning edentulous area and denture to treat denture induced stomatitis. This study assessed the use of miswak stick to reduce denture induce stomatitis inflammation. A qualitative interview and questionnaires was conducted to assess the experience of miswak stick used 15 patients suffered from denture induced stomatitis. In addition, the inflammation areas were assessed using clinical photograph for the assessment of inflammation degree and denture stomatitis classification changes and compared with control group (using toothbrush). Four weeks' result showed, no ulceration seen on the mucosa and edentulous arch. There was more than 50% (Mean=55.6%, SD±24.6%) reduction of inflammation surface area and redness. Patient with class 1 and 2 Newton's classification showed significant inflammation reduction more than 50% with 36.4% (Mean=20%, SD±9.9%) and 18.2% (Mean=20%, SD±9.9%). Patient also presented changes of the Newton's classification (n=26.7%). There is no significant different between using miswak vs conventional technique using toothbrush ($p<0.05$). Patients gave positive feedbacks of miswak on edentulous area as denture cleaning aid. In conclusion, miswak stick can be recommended as alternative oral care aid for edentulous patients and denture care.

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Introduction

In modern dentistry, toothbrushes and dentifrices are widely used in cleaning the oral cavity. This method cleans the teeth via chemical and mechanical ways. However, people are started to change this routine towards the natural products to reduce the side effects of chemical compounds in toothpaste. The most common natural aid for oral hygiene influenced by culture and traditional belief is miswak stick or *Salvadora Persica.*[1,2] In year 2000, World Health Organization (WHO) Consensus Report on Oral Hygiene stated that miswak may play a role in the promotion of oral hygiene and further evaluation of their effectiveness is warranted.[3] Miswak stick can be effectively reduced the plaque thus gingivitis due to its mechanical and chemical action.[1,2,4] However, to date, there are no reports on miswak stick being used as a tool to clean edentulous arch of denture wearers. Denture wearers usually solely depend on denture hygiene in order to maintain their oral cavity to the optimum level.

Miswak that comes from Arabic word is a chewing stick that is prepared from the roots or twigs of Arak (*Salvadora Persica)*. There are reports stating that the components of miswak have beneficial biological properties which has various is proven to have antifungal and antibacterial effects as well as promote bone formation.[2,3,5,6]

Denture stomatitis is strongly associated with occurrence of candida infection in the biofilm in denture wearer.[2,7] The bacteria in the dental

Corresponding author:
Nusima Mohamed
Senior Lecturer, Department of Restorative and Prosthodontics, Faculty of Dentistry
Universiti Sains Islam Malaysia.
E-mail: nusima@usim.edu.my

biofilm can adhere on the denture surface especially with the existence of micro porosities of denture surface. The enhancement of denture hygiene is critical to reduce the pathogeny of the dental biofilm by using toothbrush and denture cleanser in order to manage denture stomatitis. Alternatively, it was also suggested for denture disinfectant via microwave irradiation.[8] For severe cases, topical or systemic antifungal are indicated to control the disease such as ketoconazole and amphotericin. However, the compliance and duration of topical antifungal by elderly patient, appears to be not effective.

Therefore, the use of miswak stick as an alternative management for denture stomatitis is valuable. The evaluation of miswak as an oral aid for edentulous and potential alternative method for denture cleaning must be explored. The aims of this study were to assess the use of miswak stick on oral mucosa area including edentulous arch, palate and buccal mucosa and to assess any discomfort appear during its use.

Materials and methods

An ethical approval from Medical Ethical Committee obtained from the Faculty of Dentistry, Universiti Sains Islam Malaysia (USIM). Patients with diagnosed of denture stomatitis were selected based on convenience sampling. Inclusion criteria were patient with edentulous arch that wears denture without any motor skilled disability. Out of 34 patients who diagnosed with denture stomatitis that came to Prosthodontics Clinic, Faculty of Dentistry, USIM only 30 of them agreed to participate in this study due to patients is not able to come and not medically well. Some of them were not interested. This patient was then randomly selected into control group(N=15) or study group (N=15).

Methodology:

Informed consent was carried out before procedure. Pre-clinical assessment to confirm patient is having denture stomatitis. Patients were asked on their regular denture hygiene habits and histories of denture experience were interviewed to ask patient expectation and knowledge about miswak. The patient in control group was instructed to continue practice using conventional technique which is toothbrush to clean denture surface and oral mucosa after a demonstration of proper conventional technique showed. However, the interviewed was not conducted for the control group patient. Only the pre-clinical and post-clinical photo to measure the denture stomatitis surface area mapping was conducted for control group patients.

The list of questions interviewed to the study group was listed in Table 1. A pre-clinical photography was taken to record the lesion.

List of questions during pre-assessment about Miswak stick
1. *Have you heard about Miswak stick?*
2. *Do you know the use of Miswak stick?*
3. *Have you tried to use Miswak stick to clean teeth or oral mucosa?*
4. *What is your expectation about the technique of using Miswak and its ability to clean teeth and oral mucosa?*
5. *Have you used other oral aids to clean teeth and oral mucosa apart from toothbrush and toothpaste?*
6. *Will you use Miswak?*

Table 1. List of questions asked during the pre-assessment visit regarding the patient knowledge about miswak stick.

After that, patient was given denture hygiene instruction using miswak stick. The methods were taught at chair side. Patients were asked to soften miswak stick and rub on their edentulous ridge, right and left buccal mucosa area, palate and the tongue (Appendix, Figure 1). This includes the fitting surface and polished surface of their denture (Appendix, Figure 2) for two times per day; morning and before going to sleep. Patients were also reminded to remove their denture during sleep. A take home leaflet (Appendix, Figure 3) on miswak stick was prepared to assist them throughout the week.

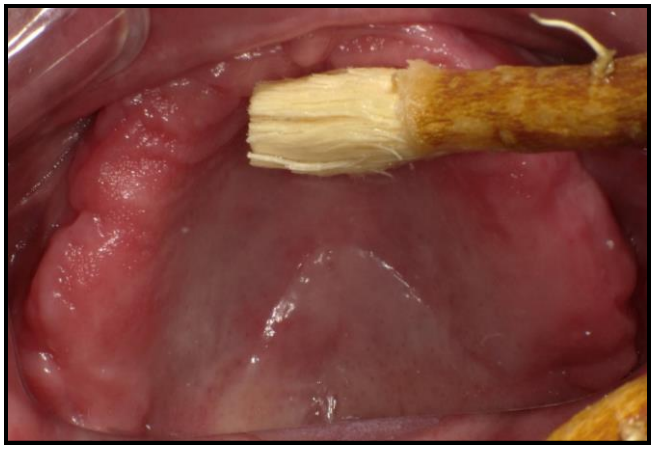

Figure 1. Photo showed the technique of using miswak to brush the palatal surface on edentulous area.

The denture stomatitis mapping area on the pre-clinical photograph was traced by 2 calibrated examiner. Then the traced photograph was scanned, and the mapping area was

measured by using the Image J Fiji software that accurately measured the irregular surface area.

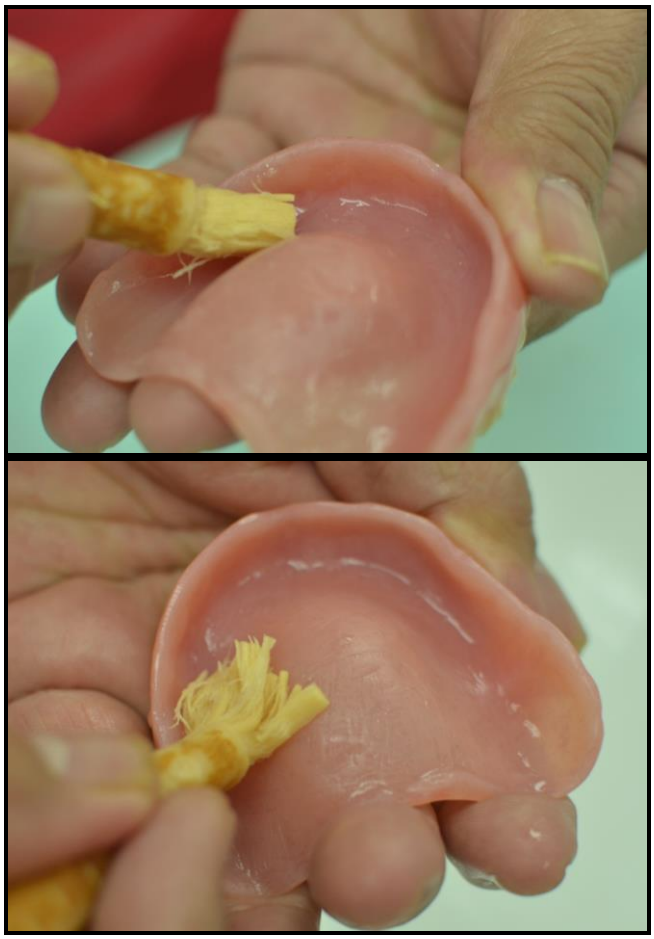

Figure 2. Photo showed the technique of using miswak to brush the denture surface (fitting surface of the denture).

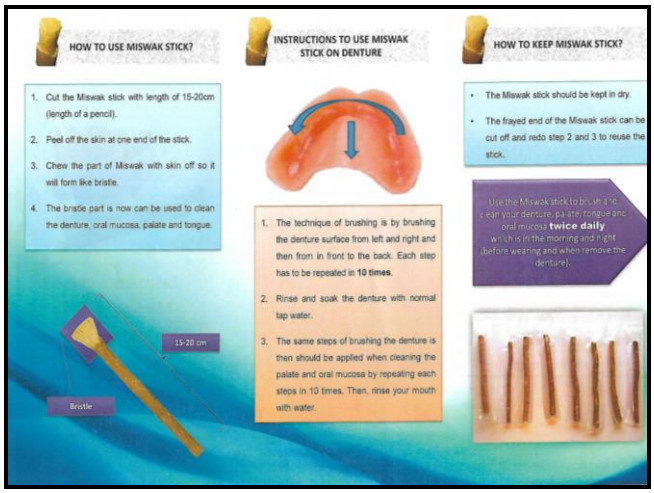

Figure 3. The leaflet that was given to patient during pre-assessment visit for their references.

After 4 weeks, patients were reviewed, and the post-clinical photography was taken. A qualitative interview was also carried out to assess appropriateness use of miswak stick on edentulous arch and patient's comfort. List of questions were listed as in Table 2. The post-clinical photograph was then traced to measure the denture stomatitis area after 4 weeks' application of miswak. The mapping area and degree of inflammation for pre- and post-clinical photograph were then compared and analysed. This mapping was also comparing between the mapping when using conventional technique (using toothbrush) to see any significant different between miswak and conventional technique.

List of questions during post-assessment about Miswak stick	
1.	Do you satisfied with the use of Miswak stick?
2.	Does it effective to clean your dentures, oral mucosa, palate and tongue?
3.	Does it feel confortable when you used Miswak stick? Any ulceration or pain during the application?
4.	Does it easy to use and clean?
5.	Is the technique of using Miswak easy and practical?
6.	Does it easy to get Miswak stick at your place?

Table 2. List of questions that been asked to patient after the practiced of using miswak.

Results

Table 3 showed denture stomatitis mapping area of the pre-clinical and post-clinical measurement and then the differential reduction of the mapping area in percentage. It showed 11 out of 15 patients (73.3%) has reduction of inflammation surface area and redness of denture stomatitis more than 50% after the use of miswak for 4 weeks with the maintenance of good denture hygiene. The mean was 55.6% of reduction.

Study showed that if patient has mild to moderate type of denture stomatitis inflammation which is Type I and Type II Denture Stomatitis Newton's Classification, regular use of miswak can show a reduction of inflammation within 4 weeks. The reduction will be more than 50% with the maintenance of good denture hygiene. This showed in Table 4 where patient with Type I and Type II Newton's Classification showed significant inflammation reduction more than 50% with 33.3% (Mean=20%, SD±9.9%) for Type I and 40.0% (Mean=20%, SD±9.9%) for Type II.

Patient also presented with changes of the denture stomatitis classification (26.7%) from Type II to Type I or from Type III to Type II Newton's Classification which showed that the

condition of denture stomatitis has improved to a better condition (Appendix, Figure 4 & 5).

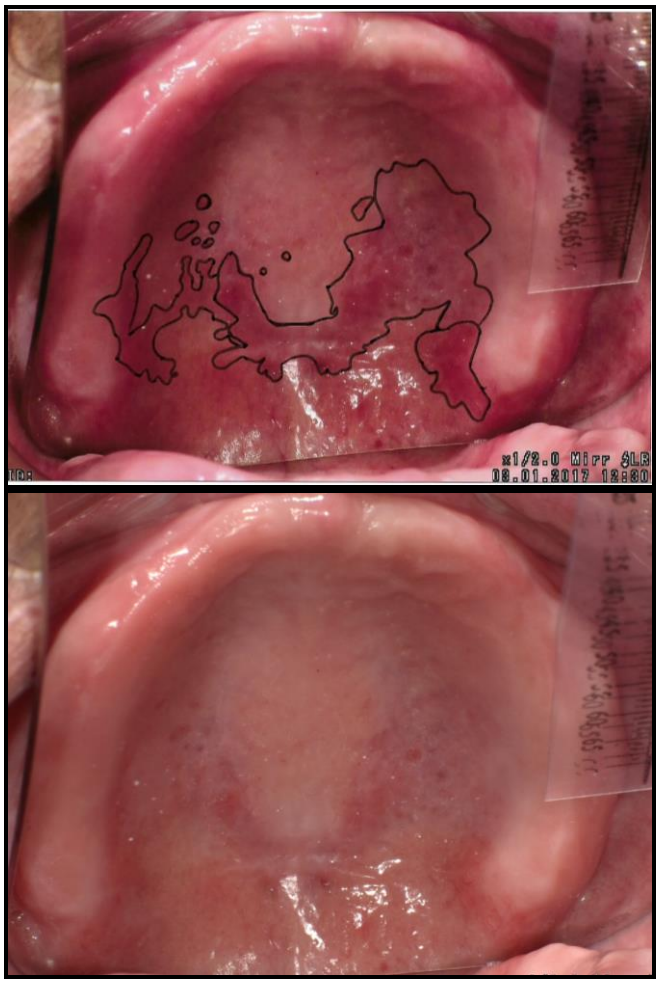

Figure 4. Left photo showed the denture stomatitis area on complete edentulous patient at posterior palatal region that has been outline. The right photo showed the reduction of inflammation and surface area of denture stomatitis after 4 weeks of the use of miswak.

When compared miswak with conventional technique using toothbrush to clean the denture surface and mucosa area, it showed no significant different ($p<0.05$). However, as for the qualitative interview, most patients gave positive feedback to the usage of miswak. All patients did not present with any ulceration or laceration on the oral mucosa. Some patients also gave feedback that miswak has mint and herbal taste that freshened the oral mucosa thus they felt that the bad breath has reduced. Besides, it is more economical as it is cheaper than toothbrush, no need toothpaste and easy to use and handle.

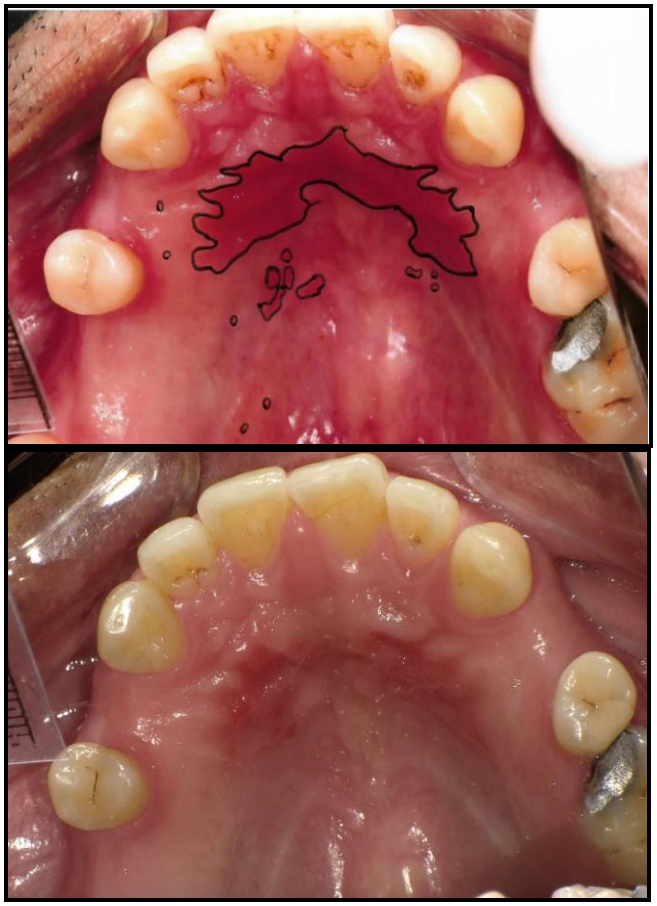

Figure 5: Left photo showed the denture stomatitis area on a partially edentulous patient at anterior palatal region that has been outline. The right photo showed the reduction of inflammation and surface area of denture stomatitis after 4 weeks of the use of miswak.

Patient	*Pre-clinical mapping area (sq area)*	*Post-clinical mapping area (sq area)*	*Percentage of reduction area (%)*
1	177.78	52.27	70.60
2	441.38	162.27	63.24
3	724.03	100.05	86.18
4	1072.61	497.78	53.59
5	452.74	349.79	22.74
6	702.83	507.07	27.85
7	1227.67	761.34	37.99
8	323.61	132.05	59.19
9	39.72	11.85	70.16
10	427.81	215.62	49.40
11	143.50	0.0	100
12	143.03	69.33	51.53
13	558.18	136.74	75.50
14	360.69	174.33	51.67
15	1655.61	635.09	61.64

Table 3. The pre- and post-clinical mapping area of denture stomatitis with the percentage of reduction from pre-clinical to post-clinical mapping.

Type of patient's denture stomatitis according to Newton's classification	Number of patient with more 50% reduction area	Percentage (%)	Number of patient with less than 50% reduction area	Percentage (%)
Type I	5	33.3	1	6.7
Type II	6	40.0	1	6.7
Type III	0	0	2	13.3

Table 4. The number and percentage of patient with less or more than 50% denture stomatitis area reduction according to Newton's Classification.

Discussion

Denture stomatitis is one of the common problems in elderly wearing complete or partial dentures. The incidence of occurrence is range from 11% to 70% for complete denture wearer.[2,8] During review visit, all patients did not complaint of mucosa ulceration when miswak stick was used. Even though miswak might be having harder bristle as compare to toothbrush, most patients said if it softened enough and they followed the instruction of brushing techniques according to the leaflet given, it will not endanger the mucosa at all. The mint and herbal taste from miswak has made patient feel fresh after brushing with miswak. The sour taste from miswak has also stimulated the saliva secretion in the oral cavity. As a result, it may be the factor of increasing the oral saliva, less dryness of mouth therefore inconvenient environment for the candida colonization.

Study show reduction of the inflammation area of denture stomatitis by more than 50%. The reduction may benefit from mechanical brushing. The mechanical activities were brushing the mucosa area; palate and tongue would increase blood microcirculation[9] and removal of plaque mechanically. Kabawat found that palatal brushing is effective in reducing denture stomatitis.[10] In addition, the reduction may be due to beneficial medical ingredient such as tannic acid and alkaloids (salvadorine) found in miswak stick.[1] Tannic acid acts as astringent that helps to reduce gingivitis by inhibiting the action of glucosyl transferase.[11] While alkaloids may have a bactericidal effect and improve the inflammation of stomatitis and gingivitis.[4] A study showed that there is 19.6% of fluoride and 26.4% of phosphorus content in a stick of miswak which effective to prevent caries and periodontal disease.[12] Based on several in vitro studies, extracts of *Salvadora Persica* also has antifungal effect to Candida species especially towards *Candida Albicans.*[5] There is evidence that aqueous extract of miswak at certain concentration has fungi static effect for 24 hours' duration as it contains chlorine, trimethylamine, alkaloid resin and sulphur compounds.[12]

The antifungal effect of miswak stick could help to reduce the adherence of candida species on the denture-fitting surface. The technique that was demonstrated to the patients was also by brushing the fitting and polishing surface of the denture with miswak. By doing this technique, the biofilm adherence to the denture surface could be reduced. Then, the chemical content of *Salvadora Persica* such as salvadorine, and the essential oils that contains benzyl nitrile can further prevent the colonisation of Candida species related to denture stomatitis.[13,14] The inhibition activity of candida both on the mucosa and denture-fitting surface helps to reduce the inflammation that caused denture stomatitis.
However, *Salvadora Persica* also contain silica and sodium bicarbonate that act as abrasive materials to remove stains. However, these materials in miswak are mild abrasive toward denture surface and have low effect of denture surface roughness. As a result, this effect may also the reason of reduction of candida adherence to denture surface due to less effect of formation of craze and increased surface roughness on denture surface. Thus, reduces denture stomatitis inflammation. Other than that, due to the content of minerals in miswak such as sodium bicarbonate, sodium chloride, potassium chloride and calcium that is proved can remove stain on teeth was reported can remove stain on denture surface.[15,16] Hence these minerals improve the denture discoloration which evidence by Ahmed and Mutlak in 2018 that miswak powder can remove and clean denture better than toothpaste and toothbrush.[15]

On the other hand, the reduction of denture stomatitis mapping area may be due to regular emphasized and better techniques of denture hygiene instruction that being taught to the patient. Patient involved has been showed the techniques of brushing or cleaning the denture carefully, soaking the denture overnight in water and removal of the denture from the mouth during sleep as routine which proven by other study before to help reduce denture stomatitis.[17] Most of denture wearers are lack of

knowledge in denture maintenance and unaware that their denture hygiene care is incorrect. Simple denture hygiene measures such as careful brushing and overnight denture soaking are efficient to remove microbial plaque on the denture.[2,16,18] Hence, efficient biofilm by any method could also reduce the occurrence of denture stomatitis.

Patients were satisfied with the use of miswak. Miswak it easy to handle, comfortable to used and easy to store, if they follow the instruction stated in the leaflet. Miswak should be stored in dry condition if it is not in use to maintain its good condition. Indeed, patients agreed that storage and cleaning the miswak using tap water is easier. It is also cost effective and easy to get.

The effectiveness of miswak towards denture stomatitis cannot be properly evaluated as this study evaluated the clinical differences only by measuring the denture stomatitis surface area and degree of redness. It is recommended that further study on the miswak minerals extract effect towards the candida species especially *Candida Albican* that mainly related to denture stomatitis *in vivo* should be done to confirm this result. Furthermore, this study also compared miswak effectiveness to reduce denture stomatitis with conventional technique which is toothbrush. The result showed no significant different between these two techniques ($p<0.05$). However, recommendation to use miswak as oral hygiene aid in edentulous arch and denture surface were proposed due to patient's positive feedback, impressive improvement of denture stomatitis condition and it is cost effective as compared to toothbrush.

Conclusions

Miswak stick has positive effect on reducing the denture stomatitis especially mild to moderate type of denture stomatitis with the good maintenance of denture hygiene. Hence, it can be recommended as the safe alternative natural product or adjunct tools to good routine denture hygiene technique as part of the management of denture stomatitis. However, long-term review is recommended to assess the effectiveness of natural product such as miswak towards denture stomatitis.

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Declaration of Interest

The authors report no conflict of interest.

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