ORIGINAL ARTICLE

The Effectiveness of Non-dominant Hand in Performing Oral Hygiene Care

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ABSTRACT

Introduction: This study aimed to assess the effectiveness of dental plaque removal and to determine factors that could influence its efficacy when using the non-dominant hand. **Methods:** A quasi-experimental study was performed on a group of dental students. Dominant hands were determined using Edinburg Handedness Inventory questionnaire, and the dental plaque scores were examined using Quigley-Hein (Turesky) index. All of the participants were examined twice for dental plaque index scores. Data obtained was analyzed using a paired t-test and an independent t-test. Factors which influenced the dental plaque removal were listed and categorized accordingly. **Results:** A total of 62 dental undergraduates participated in the study. A high percentage of them, (71%, n = 44) were found to be right-handed. There was a significant increase in the dental plaque score for the left-handed participants, from baseline (use of the dominant hand) to follow-up appointment (after brushing their teeth with non-dominant hands) ($p< 0.01$). A significant change was found between the right- and left-handed participants in the first quadrant of the buccal side ($p<0.05$). Factors identified to be beneficial in dental plaque control were; using a mirror while brushing, extending brushing time, increasing brushing frequency, using additional tooth aids and powered toothbrushes. **Conclusions:** This study revealed that left-handed participants have less ability to remove dental plaque with their non-dominant hands. The right-handed participants, showed better controls in plaque removal with their non-dominant hands, compared to their left-handed peers on the buccal side of the first quadrant.

Keywords: Oral hygiene, Oral health, Non-dominant hand, Dental plaque

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INTRODUCTION

Good oral health are maintained through proper oral hygiene care, and this includes an adequate removal of dental plaque. Dental plaque is a primary cause of carious lesion and periodontal diseases (1). Therefore, dental plaque control is essential to ensure that the required level of oral health is achieved. A thin dental plaque biofilm forms on tooth surfaces immediately after toothbrushing, and the biofilm thickness increases if the dental plaque is left undisturbed (2). Hence, reducing or eliminating dental plaque either by mechanical means or chemical means is essential.

Mechanical plaque control using toothbrushes is the most common physical means that has been used to remove dental plaque (3). Manual toothbrushing is the standard way of oral hygiene care. Despite the fact that a powered toothbrushing is more effective in dental plaque control (4), manual toothbrushing is still widely used, and it is cheaper as compared to a powered toothbrushing. There is also evidence of the use of chemical plaque control as an additional oral aid to remove or reduce dental plaque in the oral cavity (5). However, chemical plaque control alone is not sufficient in controlling dental plaque (6). Toothbrushing, if done with a proper technique, is considered an essential tool that would effectively remove dental plaque. Failure to remove dental plaque from every tooth surface will lead to oral health problems, such as periodontal disease and carious lesion (7).

A large number of people use their dominant hand, either right or left, to brush their teeth. A high 90% of them are right-handed (8). In conditions such as trauma, limited physical movements, and cognitive impairment, oral hygiene is often compromised, either due to patients' negligence, poor oral care performed by the caregivers or the use of the non-dominant hands for oral care. Poor oral conditions are often associated with the presence of oral microbiota which grows at an accelerating rate,

thus leading to not only oral diseases but also potential systemic infections, such as bacteremia or pneumonia (9).

In general, oral hygiene instructions describe the effective methods of toothbrushing without taking into consideration if it is done using the dominant hand or the non-dominant hand. An effective toothbrushing technique requires good manual dexterity (10). Activities done using the non-dominant hand are always limited, as the doers are not used to it. The use of the non-dominant hand is particularly crucial when the functions of the dominant hand are compromised, rendering the affected individuals unable to perform their routine daily activities, including toothbrushing, well. Hence, this study aimed to assess the effectiveness of oral hygiene care performed using the non-dominant hand and to determine associated influencing factors.

MATERIALS AND METHODS

A quasi-experimental study was performed on a group of dental undergraduates at the Faculty of Dentistry, Universiti Sains Islam Malaysia (USIM). The study was carried out from July 2018 to January 2019, prior to which, the ethics approval was obtained from the Ethical committee, Faculty of Dentistry, USIM, Malaysia. The study was approved and registered with the study registration number of PPI/TB/FPG/13318. It was conducted in full compliance with the World Medical Association Declaration of Helsinki.

The inclusion criteria of this study were; dental undergraduates studying at the Faculty of Dentistry USIM, those not wearing braces or undergoing orthodontic treatment, and those not having a temporomandibular joint problem. The students who fulfilled the inclusion criteria were invited to participate in the study. Due to a limited time frame, the subjects were recruited among the dental student from one dental faculty. The students with left-handedness were identified and multiple the control of subject ratio of one left-handedness to two right-handedness. Therefore 18 left-handedness with 44 right-handedness were recruited.

Those right-handedness were randomly selected using simple random sampling. As for the left-handed, they were encouraged to be involved in the study, since they made up a lower number compared to the right-handed. Information sheets about the study were distributed to those willing to participate in the study, and they were allowed to ask questions with regards to the process of the research, before the research commenced. Following this, they were given a written consent form and an Edinburg Handedness Inventory questionnaire. A new toothbrush was given to each of the participants, to be used daily, the way they routinely do it and no new technique was taught. Besides, the participants were required to abstain from the use of additional oral aids, such as mouth rinse and floss, until the completion of the study. The first oral examination was conducted a week after they completed their daily toothbrushing using the dominant hand. Data obtained for the dominant hand was taken as the baseline data. The participants were subsequently required to do their daily toothbrushing routine for another week, using their non-dominant hand, after which completion, the second oral examination and assessment were performed.

A trained examiner performed the oral examination and assessment of all the participants during both visits, using a hard copy of the scoring systems as a guideline. The intra-examiner reliability was performed on a total of 10% of the participants involved in the study. The Kappa value of the dental plaque score calculated was 0.8.

Dental plaque score was assessed using plaque disclosing tablets and based on Quigley-Hein Index (Turesky). The Quigley-Hein Index (Turesky) records the level of dental plaque at two sites of each tooth. The index consists of six scores; 5 = presence of plaque covering two-thirds or more of the crown of the tooth, 4 = presence of plaque covering at least one-third, but less than two-thirds of the crown of the tooth, 3 = presence of plaque wider than 1 mm covering less than one-third of the crown of the tooth, 2= presence of continuous plaque less than 1 mm at the cervical margin of the tooth, 1 = flecks of plaque at the cervical margin of the tooth, and 0 = absence of plaque. The type of dental prosthesis was also recorded. Hand preference or dominance was determined using Edinburg Handedness Inventory-Short Form (11). During the second follow-up, the participants were asked to answer two-open ended questions as follows; i) what are the limitations which you encountered during toothbrushing when using the non-dominant hand? and ii) what are the factors that may help you to achieve better oral hygiene when using the non-dominant hand? The individual responses were listed, identified and categorized accordingly.

The primary outcome of this study was to evaluate the changes in the dental plaque score by comparing the results obtained at the baseline (use of the dominant hand) and those during the follow-up when using the non-dominant hand. The differences in scores within the groups and each quadrant of the group, were obtained by comparing and analyzed the results of the pre- and post- assessments using a paired t-test. Meanwhile, the differences between quadrants of the right- and left-handed were analyzed using an independent t-test. The data analysis was conducted using IBM SPSS version 24.0, and the *p*-value was set at less than 0.05.

RESULTS

A total of 62 dental undergraduates were recruited for the study. Three-quarters of the participants were female

(n = 47, 75.8%). Almost three-quarters of the participants were found to be right-handed (n = 44, 71%), and nearly all of them brushed their teeth twice or more a day (n = 60, 96.8%). Prior to the study, very few of them had used mouthwash (n = 8, 12.9%), and almost half of them used floss (n = 29, 46.8%). Approximately 90% (n = 57) of them used the combination brushing techniques, while almost half of them (n =29, 46.8%) claimed that they were not able to use the same brushing technique when using their non-dominant hand (Table I).

Table I: Summary characteristics of participants (n=62)

Variables	Frequency (%)
Gender	
Male	15 (24.2)
Female	47 (75.8)
Year of study	
First	20 (32.3)
Second	8 (12.9)
Third	12 (19.4)
Fourth	13 (21.0)
Fifth	9 (14.5)
Dominant hand	
Right	44 (71.0)
Left	18 (29.0)
Frequency of brushing	
Once daily	2 (3.2)
Twice or more daily	60 (96.8)
Use of mouthrinses	
No	54 (87.1)
Yes	8 (12.9)
Flossing	
No	33 (53.2)
Yes	29 (46.8)
Brushing technique	
No motion/unknown	3 (4.8)
Combination	57 (91.9)
Vertical & circular	2 (3.2)
Same technique	
No	29 (46.8)
Yes	33 (53.2)

There was no significant difference found in dental plaque scores between the right- and left-handed participants at the baseline and after toothbrushing with their non-dominant hands. Similarly, there was no significant difference observed among the right-handed participants at the baseline and after toothbrushing with their non-dominant hands (t=2.02, df=43, p = 0.050). On the contrary, there was a significant increase in dental plaque scores among the left-handed participants at the baseline and after toothbrushing with their non-dominant hands (t=4.22, df=17, p < 0.01) (Table II).

Using non-dominant hands, the dental plaque scores were lower in most of the quadrants before toothbrushing, as compared to the scores obtained after toothbrushing.

Table II: Oral hygiene score between right- and left-handed participant using Quigley Hein Index at baseline (with dominant hand) and after (with non-dominant hand)

Dominant hand	N	Mean (SD)		*P-value
		Baseline	After	
Right-handed	44	2.89 (0.66)	3.04 (0.61)	0.050
Left-handed	18	2.57 (0.70)	2.90 (0.62)	0.001

* paired t-test

There were significant increases in dental plaque scores of the right-handed participants on the second quadrant of the palatal site (p = 0.028), third quadrant of lingual (p = 0.006) and fourth quadrant of the buccal site (p < 0.001). A more significant increase in dental plaque scores can be observed among the left-handed participants when they used their non-dominant hands (p < 0.05), except for the fourth quadrant on the lingual surface (p = 0.071). Independent t-test of comparison between the left- and the right-handed participants found a significant difference in dental plaque score at the first quadrant of the buccal site (p=0.014) (Table III).

Table III: Oral hygiene score at baseline and after changing to non-dominant hand for right- and left-handed participant based on quadrant and site

Quadrant	Baseline	After	*P-value
Right			
First			
Buccal	3.13 (1.13)	2.94 (1.07)	0.140
Palatal	2.85 (0.73)	2.98 (0.75)	0.146
Second			
Buccal	2.75 (1.12)	2.71 (1.12)	0.323
Palatal	2.90 (0.76)	3.15 (0.64)	0.028
Third			
Buccal	2.26 (1.10)	2.35 (1.05)	0.484
Lingual	3.48 (0.85)	3.75 (0.65)	0.006
Fourth			
Buccal	1.88 (0.98)	2.55 (0.96)	<0.001
Lingual	3.55 (0.73)	3.71 (0.67)	0.114
Left			
First			
Buccal	2.41 (1.24)	2.80 (1.27)	0.044
Palatal	2.60 (0.73)	2.99 (0.56)	0.005
Second			
Buccal	2.40 (1.14)	2.40 (1.14)	-
Palatal	2.56 (0.66)	3.03 (0.44)	0.003
Third			
Buccal	1.94 (1.14)	2.33 (1.10)	0.031
Lingual	3.29 (0.83)	3.56 (0.60)	0.009
Fourth			
Buccal	1.51 (0.94)	2.05 (1.09)	0.001
Lingual	3.49 (0.59)	3.76 (0.55)	0.071

*Paired t-test

[Independent t-test showed a significant difference between right- and left-handed participant at first quadrant of buccal site (t=2.542, df=60, mean diff= 0.58, p=0.014)]

Keywords that were raised for question one (i.e. related to the limitations they encountered during toothbrushing) were; difficulty to brush, time-consuming and tired. There were four contributing factors identified in this study, which caused difficulties while brushing; unergonomic toothbrush handgrip, controlling the toothbrush, angulating the toothbrush, and awkward feeling. Keywords that were raised for question two (i.e. factors that may lead to better oral hygiene when using the non-dominant hand) were; using a mirror, brush slowly, extend brushing time, use of a powered toothbrush, support from the dominant hand, use of multiple toothbrushing techniques, increase the frequency of brushing, and use of additional oral aids, such as mouthwash.

DISCUSSION

This study aimed to assess the effectiveness of oral hygiene care using the non-dominant hand and also to identify factors that may influence oral hygiene care when using the same hand. Studies on the ability of the non-dominant hand to perform proper oral hygiene are very few. Most related researches focused on the dominant hand and their ability to perform good oral hygiene. Daily activities, including oral hygiene care, which is performed by the non-dominant hand, become crucial when the dominant hand is affected due to injury, pain or paralyzed following a stroke attack, motor vehicle accident or infections.

At the baseline, the dental plaque scores among the right-handed participants were higher compared to those of their left-handed peers, although the difference was not statistically significant. These results were in line with those of other studies which reported that the left-handed individuals had better oral hygiene care, compared to the right-handed individuals (12) (13). The left-handed individuals were also found to have less caries lesion and less oral halitosis (10). However, this finding was in contrast to that by Cakur et al. (14), who reported that the right-handed individuals had a lower incidence of caries lesion and better oral hygiene, compared to the left-handed individuals. On the other hand, when the participants brushed their teeth with the non-dominant hand, the dental plaque scores for the left-handed participants were found to be higher, compared to the right-handed participants.

With regards to the findings of dental plaque scores on specific quadrants, it showed that there was a significant difference at the first quadrant on the buccal side between the right- and left-handed participants. There was a reduction in dental plaque scores of right-handed participants, from the baseline (use of the dominant hand) to the use of the non-dominant hand on the buccal side of the first and second quadrants, although it was not statistically significant. In addition, the current study showed that the dental plaque score increased when the non-dominant hands were used for both groups, with more significant changes observed among the left-handed participants. This suggests that the non-dominant hands of the left-handed were less capable to clean the teeth. For both groups, the fourth quadrant and the the buccal side area showed a much increased dental plaque score from the baseline to the use of the non-dominant hand. This is in line with the finding by Kadkhodazadeh et al. (13) in their study on the ability of the dominant hand to remove plaque. The study revealed that the right-handed individuals had higher dental plaque scores on the lower right and upper left quadrants. Another study on the preferred use of hand reported that more dental plaque was found among right-handed participants on the right side of the mouth, as compared to their left-handed peers. Although the left-handers were found to have more dental plaque on the left side compared to the right side, the difference was not statistically significant (8). They also claimed that cleanliness of the mouth, either on the left side or the right side was dependent on the dominant hand.

This different extent of cleanliness on both sides of the mouth may also be related to the distribution of the cerebral functions. A left-handed person is described as having a non-dominant or a minor hemisphere (i.e. the right-brain) as opposed to the right-handed person who has a dominant or a major hemisphere (i.e. the left-brain) (15). The right hemispheres are specified for a figure, geometry, drawing, touching and audio, while the left hemispheres are for more verbal abilities such as literature, philosophy and poetry (12,16). Besides, activities of daily living skills and gross motor performance are controlled by the contralateral side (17). The functional activities, such as manual dexterity and grip strength, are reported to be greater for the right-handed individuals compared to the left-handers (18). Furthermore, this current study revealed that there was a significant increase in most of the quadrants of the left-handed participants, compared to the right-handers. There was more dental plaque observed among the left-handed when they switched to the right hand, although they were claimed to be more flexible than the right-handed (19). Hence, this supports the current findings that the non-dominant side of the right-handed individuals can perform better, compared to the non-dominant side of their left-handed peers. As a result, the left-hand per se seem to be more flexible in completing assigned tasks (20).

A number of factors were identified to influence the toothbrushing efficiency when using the non-dominant hand, namely dexterity problems, longer times required to brush teeth and exhaustion. Performing a common task using the non-dominant hand will limit its functions. Longer times are needed to complete a common task or to get used to doing it. When someone is having problems with his or her dominant hand, he or she has to resort to using the non-dominant hand to perform daily activities, despite the feeling of being awkward and tired. Therefore, training of the non-dominant hand may be required to ensure that a common task can be completed effectively. A study found that oral hygiene education (face to face motivation and effective toothbrushing techniques) could improve oral health status (12).

Oral hygiene instructions may need to focus on the use of the non-dominant side and factors that may help in oral hygiene care, whenever the functions of the dominant hand become impaired. Looking into a mirror while brushing the teeth has been recommended as one of the factors that may help to ensure that tooth surfaces are cleaned accordingly. Besides, powered toothbrushes have also been strongly recommended for

those with disabilities or functional limitations following a stroke attack or trauma. The effectiveness of powered toothbrushes, compared to the manual toothbrushes in removing dental plaque, has been reported (21).

It was reported by the participants in this study that handling the toothbrush with the non-dominant hands was difficult. Almost half of them claimed that they were unable to brush their teeth with the technique they would normally do with their dominant hands. Therefore, they were not able to clean their teeth properly, and they recommended that a longer time be given for a more effective toothbrushing. They also proposed an increase in the frequency of brushing to more than twice a day and use of additional oral aids, such as mouthwash. Brushing teeth at least twice a day has become the universal recommendation for good oral hygiene, while infrequent tooth brushing has shown to be associated with a higher incidence of carious lesion (22). Meanwhile, the use of mouthwash for plaque control has been practised and highly suggested in a condition where physical means of dental plaque control are difficult to maintain (23).

There were several limitations to be pointed out in this study. Firstly, the sample size used was small in number, due to time frame and financial constraints. Therefore, the study was done at only one institution, and the result may not be generalized to other population. However, the findings could benefit those having problems with their dominant hand. It would be highly recommended to conduct a more in-depth study involving a higher number of participants to get more comprehensive results. Nevertheless, this study is important as it provides basic information for future researches. Secondly, the compliance of the participant was solely based on self-reports and assessment on the dental plaque control. These may have introduced a significant bias as the participants might have their awareness about the oral hygiene condition and as a result, they might improve their oral hygiene care even when using the non-dominant hand. Thus, more study in this area is warranted to provide more information in dealing with non-dominant hand and its relations with the oral health conditions.

CONCLUSION

This study demonstrated the ability of the non-dominant hand in performing oral hygiene care and identified factors that may help to increase the effectiveness of toothbrushing when using the non-dominant hand. Oral hygiene care is compromised if the effective method of toothbrushing is not carried out. Thus, health care providers need to be aware of the anticipated consequences if untrained non-dominant hands are used to perform oral hygiene care, and oral health education programmes should also consider the use of non-dominant hands. Adequate training and appropriate oral hygiene instructions related to the use of non-dominant hands are essential for those having difficulties with their dominant hands.

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