

Plaque Removal Ability in Left- and Right-handed Patients in Different Parts of the Oral Cavity

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Abstract

Background and aims. The aim of this study was to evaluate the effect of right/left handedness on the ability of patients to remove dental plaque in various quadrants of the mouth.

Materials and methods. This double-blind cross-sectional study was conducted in two phases with a two-week time interval, on 40 subjects. During the two visits, the subjects were requested to brush their teeth for 3 minutes with a soft toothbrush without a dentifrice using the Bass technique. Pre- and post-brushing plaque indexes (PI) were measured for all the dental surfaces in various quadrants of the mouth.

Results. Following plaque removal at the end of the first phase, RH subjects had higher average of PI in upper left quadrants compared to upper right quadrants ($P=0.044$), whereas lower right quadrants had higher average of PI compared to lower left quadrants ($P=0.387$).

Conclusion. This study indicates that LH subjects have better ability to access the right quadrants of the mouth to perform oral hygiene procedures, whereas RH subjects are more successful in plaque control of the left quadrants.

Key words: Dental plaque, oral hygiene, right- or left-handedness, tooth brushing.

Introduction

Dental plaque is the primary etiological factor in the development of caries and inflammatory diseases such as gingivitis and periodontitis.¹ Periodontitis is a chronic disease of microbial origin with a multifactorial etiology, which results in inflammation of supporting tissues of the tooth, advancing loss of attachment and bone resorption.^{2,3} Prevention, elimi-

nation and control of dental plaque formation are important steps in the prevention of gingivitis as well as in minimizing the severity of periodontal disease. Removal of dental plaque can be categorized into three mechanical, chemical and antimicrobial methods. Such measures can be carried out either by the patient or professionally by oral health care providers.¹

Mechanical plaque removal is mainly carried out by

the use of a toothbrush, which is the most efficient and common method of mechanical plaque control at home.⁴ Toothbrushes are divided into two main categories of hand and electrical. For most individuals, use of a hand toothbrush is considered to be the most popular and appropriate method of mechanical plaque control.^{5,6} It should be emphasized that many factors such as quality of the brush, length, diameter and number of bristles, design of the handle, angle of the head with the handle, and shape and length of head are important in the efficacy of a toothbrush. However, correct method of brushing has a more significant effect compared to all those factors mentioned before.⁷

In addition, another important factor in the efficacy of a toothbrush is the right/left handedness of individuals and their level of access to dental plaque. Defects such as tooth abrasion were more commonly seen in the upper teeth compared to the lower teeth, and also more common on the left side of the mouth compared to the right side. It seems that access and right/left handedness may have an effect on levels of abrasion and plaque accumulation.⁸ There is limited evidence gained indirectly and by clinical experiments, regarding the difference in plaque indices in various quadrants of the mouth between right-handed (RH) and left-handed (LH) individuals. The aim of the present study was to compare the differences in plaque index (PI) scores in various quadrants of the mouth between RH and LH individuals.

Materials and Methods

This double-blind cross-sectional study was carried out in two phases in 2010. A total of 40 students from Hamadan University of Medical Sciences were enrolled after giving their informed consent. Subjects undergoing orthodontic and prosthodontic treatment, those with defective intra-oral restorations and crowns, individuals with pocket depths >4 mm, and those undergoing antibiotic or immunosuppressive drug therapy were excluded from the study.

In this study, a soft hand toothbrush (G.U.M, John O. Butler Co, Chicago, USA) was used. The effect of right/left handedness of subjects on the levels of plaque control in various quadrants was assessed. All the subjects were assigned a unique code, requested to refrain from brushing their teeth for 12 hours prior to attendance, and were asked to have their usual daily breakfast.

In the first phase of the study, after recording an initial PI for each subject, they were given a soft toothbrush, and the correct method of brushing was then instructed using the Bass technique. Instructions

were provided verbally on a model and practically in the mouth, using the same instructor for both RH and LH groups. During the first phase of the study, microbial plaque was detected using a disclosing agent (Oral-B, Procter & Gamble Co., Ohio, USA), and PI scores were recorded blindly by the same examiner for all tooth surfaces using O'Leary plaque index.⁹ The subjects were then given toothbrushes and requested to brush their teeth without a dentifrice for 3 minutes. Clinical measurements of PI were then recorded in data sheets by the same examiner using O'Leary plaque index. The subjects were then requested to brush their teeth for 3 minutes three times per day for two weeks.

To eliminate the intervention of oral hygiene instruction, at the second phase of the study (after two weeks), the subjects repeated the same steps as in the first phase: they refrained from brushing their teeth for 12 hours prior to attendance, had their usual diet for breakfast, and avoided eating very soft or hard foods. Clinical measurements of PI for all tooth surfaces were then recorded using the O'Leary plaque index for each subject before and after brushing, and recorded as a percentage in the data sheets. Examination and recording of PI in all the subjects were carried out by the same expert examiner during both phases of the study. Data was analyzed using an appropriate statistical software program. Paired and independent *t*-tests were used for the analysis of the results, comparison of differences in PI before and after brushing and analysis of the effect of right/left handedness on PI scores in various quadrants of the oral cavity. The level of significance was set at 0.05.

Results

The results indicated that during the first phase of the study and prior to brushing, there was a significant difference in average PI scores between the upper left (UL) and upper right (UR) quadrants (79.84 ± 13.35 and 73.23 ± 19.11 , respectively) in right-handed subjects ($P=0.044$). In relation to the lower jaw, the initial average PI scores in the lower right (LR) quadrants (72.92 ± 22.15) were higher than the lower left (LL) (68.25 ± 20.57). However, this difference was not statistically significant ($P=0.387$) (Table 1).

In left-handed subjects, there were no significant differences in initial PI scores of UR and UL quadrants, and LR and LL quadrants of the oral cavity (Table 2).

During the second phase of the study, the average initial PI of right-handed subjects did not exhibit any significant difference between UR (49.97 ± 18.21) and UL quadrants (49.26 ± 15.66). A significant difference

($P=0.03$) was observed between LR (60.68 ± 20.69) and LL quadrants of the oral cavity (50.86 ± 16.29) (Table 3).

Regarding the average initial PI scores of left-handed subjects during the second phase of the study,

there was no significant difference between UR (61.22 ± 19.81) and UL quadrants (61.26 ± 22.36) and between LR (68.76 ± 17.23) and LL quadrants (60.79 ± 24.25) as shown in Table 4 ($P=0.071$).

Table 1. Comparison between various oral cavity quadrants' PI in right-handed subjects (the first phase of the study)

Site	Mean (%) \pm SD	Mean diff	P*
ULB	73.23 \pm 19.11	-6.6 \pm 13.69	0.044
URB	79.84 \pm 13.35		
LRB	72.92 \pm 22.15	4.66 \pm 23.58	0.387
LLB	68.25 \pm 20.57		
URA	29.79 \pm 16.18	6.85 \pm 15.16	0.058
ULA	22.93 \pm 13.44		
LRA	40.68 \pm 12.89	15.33 \pm 14.77	0.000
LLA	25.35 \pm 13.61		

URB: Upper right quadrant before brushing; ULB: Upper left quadrant before brushing; LRB: Lower right quadrant before brushing; LLB: Lower left quadrant before brushing; URA: Upper right quadrant after brushing; ULA: Upper left quadrant after brushing; LRA: Lower right quadrant after brushing; LLA: Lower left quadrant after brushing. * paired t-test

Table 2. Comparison between various oral cavity quadrants' PI in left-handed subjects (the first phase of the study)

Site	Mean (%) \pm SD	Mean diff	P*
ULB	63.15 \pm 20.71		
URB	63.50 \pm 20.30	-0.34 \pm 14.79	0.918
LRB	66.98 \pm 16.29		
LLB	67.83 \pm 13.49	-0.84 \pm 11.26	0.741
URA	23.37 \pm 14.96		
ULA	25.17 \pm 13.95	-1.79 \pm 11.26	0.320
LRA	29.08 \pm 16.59		
LLA	29.10 \pm 18.09	-0.02 \pm 12.46	0.994

URB: Upper right quadrant before brushing; ULB: Upper left quadrant before brushing; LRB: Lower right quadrant before brushing; LLB: Lower left quadrant before brushing; URA: Upper right quadrant after brushing; ULA: Upper left quadrant after brushing; LRA: Lower right quadrant after brushing; LLA: Lower left quadrant after brushing.

* paired t-test

Table 3. Comparison between various oral cavity quadrants' PI in right-handed subjects (the second phase of the study)

Site	Mean (%) \pm SD	Mean diff	P*
ULB	49.97 \pm 18.21		
URB	49.26 \pm 15.66	0.71 \pm 15.69	0.841
LRB	60.68 \pm 20.69		
LLB	50.86 \pm 16.29	9.82 \pm 18.69	0.030
URA	27.20 \pm 14.31		
ULA	16.38 \pm 8.94	10.82 \pm 14.52	0.003
LRA	30.73 \pm 11.44		
LLA	17.05 \pm 12.00	13.68 \pm 10.92	0.000

URB: Upper right quadrant before brushing; ULB: Upper left quadrant before brushing; LRB: Lower right quadrant before brushing; LLB: Lower left quadrant before brushing; URA: Upper right quadrant after brushing; ULA: Upper left quadrant after brushing; LRA: Lower right quadrant after brushing; LLA: Lower left quadrant after brushing.

* paired t-test

Table 4. Comparison between various oral cavity quadrants' PI in left-handed subjects (the second phase of the study)

Site	Mean (%) \pm SD	Mean diff	P*
ULB	61.22 \pm 19.81		
URB	61.26 \pm 22.36	-0.04 \pm 11.04	0.987
LRB	68.76 \pm 17.23		
LLB	60.79 \pm 24.25	7.96 \pm 18.66	0.071
URA	33.74 \pm 12.87		
ULA	29.57 \pm 16.60	4.17 \pm 15.74	0.250
LRA	34.08 \pm 10.96		
LLA	27.98 \pm 15.54	6.09 \pm 14.55	0.077

URB: Upper right quadrant before brushing; ULB: Upper left quadrant before brushing; LRB: Lower right quadrant before brushing; LLB: Lower left quadrant before brushing; URA: Upper right quadrant after brushing; ULA: Upper left quadrant after brushing; LRA: Lower right quadrant after brushing; LLA: Lower left quadrant after brushing.

* paired t-test

Discussion

The aim of the present study was to assess the effect of right/left handedness on PI scores in various quadrants of the oral cavity. There are some previous studies which have assessed various factors in RH and LH individuals such as the prevalence of gingival recession.¹⁰⁻¹³ However, as there is not any published data on PI scores in various quadrants of the oral cavity in RH and LH individuals, comparison of the results of the present study was not possible.

Comparison of initial PI prior to brushing indicated that left-handed subjects showed higher level of oral hygiene (OH) compared to right-handed ones. The initial average PI of LH subjects was lower than that of RH subjects; however, this difference was not statistically significant. This finding is a reflection of the fact that prior to the start of the study, left-handed subjects performed oral hygiene procedures better compared to right-handed ones. In a study carried out in 2001 by Tezel et al,¹⁰ the amount of gingival recession was assessed in RH and LH individuals. It was found that LH individuals had superior hygiene compared to RH ones. Although this difference was not statistically significant, the results were in line with the results of the present study. In addition, Cicek and colleagues conducted a study in 2010 assessing the differences in levels of oral halitosis between LH and RH subjects.¹⁴ They concluded that there was a statistically insignificant difference in PI between RH and LH subjects, which was also in line with the results of the present study.

However, the results were not repeated during the second phase of the study, so that the average initial PI was higher in LH compared to RH subjects, although this difference was not statistically significant. Such difference in results between the first and second phases of the study might be due to participants' higher motivation leading to successful learning of taught OH instructions, followed by improved application of the instructions in performance of OH procedures. Therefore, during the time interval between the first and second phases of the study, RH subjects were more successful in performing OH procedures compared to LH subjects. It seems the results of the first phase of the study are more reliable compared to the second phase, as they are representative of the daily routine of the subjects, away from the specific conditions of the study, whereby no additional factors were used to improve motivation and learning of the taught OH procedures. In addition, the majority of previous studies have reported that motivation has a periodic nature, the effect of which is slowly diminished after two months.¹⁵

Comparison of initial PI in various quadrants of right-handed subjects during the first phase of the study indicated that oral health was superior in the UR quadrant compared to the UL quadrant. There was a statistically significant difference in average PI of the UL quadrant, which was higher than the UR quadrant. In relation to the lower jaw, level of attention to the LL quadrant was higher than the LR quadrant, so that there was a difference in average PI of LR and LL quadrants, although this difference was not statistically significant. After a two-week time interval between the first and second phases of the study, comparison of average PI was carried out. It was revealed that in right-handed subjects, there were no statistically significant differences between the average PI of UR and UL quadrants, although statistically significant differences were observed in average PI scores of the lower jaw, so that the subjects were found to perform superior OH and had better access in LL quadrants compared to LR quadrants. In this study, the participants were requested to refrain from performing any OH procedures for 12 hours prior to attendance. The 12-hour period is similar to previous studies in which PI scores have been evaluated.¹⁶⁻¹⁸ Comparison of reduction in PI before and after brushing in various quadrants of right-handed individuals during the two phases of the study showed that right-handed subjects performed superior OH on the left side of the oral cavity compared to the right side, although this difference was only statistically significant in the upper jaw. This finding indicates that right-handed subjects had better access to the left side of the oral cavity compared to the right side. The results also indicated that during the first phase, average PI of left-handed subjects in the right and left quadrants did not reveal a statistically significant difference. This was also the case for the second phase, so that levels of access and average PI in the UL and UR quadrants did not show a statistically significant difference. However, in the lower jaw, average PI was higher in the LR quadrant compared to the LL quadrant, and the level of access was higher in the LL quadrant compared to the LR quadrant in the interval between the two phases of the study.

During the first phase, amount of reduction in PI of left-handed subjects before and after brushing indicated that after receiving tooth brushing instructions using the Bass technique, levels of access to the left and right sides of the oral cavity were similar. During the second phase, the amount of reduction in PI indicated that left-handed individuals performed superior

OH in the UL and LR quadrants. However, this finding was not statistically significant.

Comparison of reduction in PI before and after brushing between left- and right-handed subjects during the first phase revealed that right-handed subjects brushed all the quadrants except the LR quadrant superiorly compared to left-handed subjects, although this difference was only statistically significant in the UL quadrant. However, in the second phase, left-handed individuals performed superior OH on the right side of the oral cavity compared to right-handed subjects. Performance of OH on the left side of the oral cavity in right-handed individuals was slightly superior to left-handed subjects, although this difference was not statistically significant.

Results of the present study indicated that initial PI prior to brushing had reduced in the second phase compared to the first phase, and this reduction was greater in right-handed subjects. This finding might be attributed to higher success of right-handed subjects in learning toothbrushing instructions, higher motivation in performance of OH procedures, and application of the instructions in the interval between the two phases of the study. The results also indicated that the amount of reduction in PI before and after brushing was lower in the second phase compared to the first phase of the study, which might be attributed to lower initial (before brushing) PI in the second phase of the study, lower precision of subjects in performance of OH procedures and possibility of the subjects forgetting to follow the OH instructions provided during the first phase. This finding emphasizes the importance of reinforcing OH instructions at frequent time intervals, which should initially be shorter (less than one week), and lengthened following the establishment of an acceptable level of OH relative to the individual's needs. In a similar study carried out by Kimmelman,¹⁹ it was reported that after one instruction session and assessments at 14- and 21-day intervals, only 24% of the participants performed the Bass technique correctly. Gibson and Wade also believed that a single OH instruction session was inadequate, even if the instructions were provided for dental students, and the students' abilities were confirmed following verbal and practical instructions on a model and in the oral cavity.²⁰

Conclusion

It was concluded that in terms of performance of OH procedures and level of access to the right side of the oral cavity, left-handed individuals were more successful than right-handed subjects. However, in relation to the left side of the mouth, right-handed indi-

viduals were more successful.

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