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Original Article

Relationship between handedness and toothbrush-related cervical dental abrasion in left- and right-handed individuals

Mehmet Özgöz ^{1,*}, Taner Arabaci ¹,
Mehmet Akif Sümbüllü ², Turgut Demir ¹

¹ Department of Periodontology, Atatürk University, Faculty of Dentistry, Erzurum, Turkey

² Department of Oral Diagnosis and Radiology, Atatürk University, Faculty of Dentistry, Erzurum, Turkey

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KEYWORDS

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Abstract *Background/purpose:* Cervical tooth abrasion is the loss of tooth material at the cemento-enamel junction, and is usually related to faulty brushing habits. In this study, we attempted to evaluate the effects of handedness on tooth-brushing abrasion in terms of brushing habits in left- and right-handed adults.

Materials and methods: In total, 488 subjects participating in the study were divided into 2 groups according to hand preference (group I; left-handed and group II; right-handed), and were interviewed about their brushing habits, and their clinical oral conditions such as the plaque index (PI), gingival index (GI), and tooth wear index (TWI) were determined. Handedness was determined by a questionnaire that focused on handedness using the Turkish version of the Edinburgh Handedness Inventory.

Results: This study showed that there were no statistically significant differences between groups I and II according to daily tooth-brushing habits, PI, or GI. Statistically significant differences were found between men and women according to the clinical oral scores and brushing habits ($P < 0.01$). However, there were no statistically significant differences between the mean TWI scores of left- and right-handed groups ($P = 0.12$). It was found that an increased frequency and longer duration of tooth-brushing significantly increased the TWI scores in both groups ($P < 0.01$). It was also found that TWI scores were statistically higher in subjects who brushed horizontally rather than vertically ($P < 0.01$). Correlations between clinical oral scores (TWI, PI, and GI) and brushing habits were statistically significant ($P < 0.01$).

* Corresponding author. Atatürk Üniversitesi Diş Hekimliği Fakültesi, Periodontoloji Anabilim Dalı, 25240 Erzurum, Turkey. Fax: +90 4422360945.

E-mail address: mehmetozgoz@hotmail.com (M. Özgöz).

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Conclusion: The oral-hygiene performance of females was better than males. Brushing habits of patients were related to the severity of cervical wear. But no statistically significant relationship was found between hand preference and tooth-brushing abrasion in this study. Copyright © 2010, Association for Dental Sciences of the Republic of China. Published by Elsevier Taiwan LLC. All rights reserved.

Introduction

Cervical tooth wear or tooth abrasion is defined as the loss of tooth substance that occurs in the absence of carious mechanisms at the cemento-enamel junction of a tooth.^{1–3} Cervical abrasion may vary in clinical presentations among individuals, and may cause painful sensations linked to dentinal hypersensitivity and impair an individual's oral-hygiene performance during tooth-brushing.⁴ Since dental and periodontal problems are usually linked to the oral-hygiene performance of individuals, tooth-brushing is obviously important. Tooth-brushing is the simplest and most effective way to meet oral-hygiene requirements for removing bacterial plaque from tooth surfaces. However, cervical dental abrasion and gingival recession in the vestibule area are mostly caused by improper tooth-brushing.^{5,6} Problems with brushing are commonly related to technique, duration, daily frequency, and the force applied when brushing.^{7–10} In addition, traumatic cervical dental abrasion caused by tooth-brushing may also depend upon the manual dexterity and cognitive ability of individuals.¹¹ Hand preference was stated as one of the most important parameters affecting cognitive abilities and proficiency.^{12–16} Although several studies evaluated the effects of brushing variables on tooth abrasion,^{4,17,18} there is a lack of investigations assessing the relationship between hand preference and cervical tooth defects. Therefore, the present study investigated the relationship between abrasion caused by tooth-brushing and hand preference in left- and right-handed individuals in terms of gender and brushing habits.

Materials and methods

Study population

The present study was carried out in Erzurum, Turkey, in 2009, and included 488 subjects (253 females and 235 males) who reported to the Department of Periodontology (Faculty of Dentistry, Atatürk University). Subjects participating in the study were divided into 2 groups according to their hand preference. Handedness was determined by a questionnaire that focused on handedness using the Turkish version of the Edinburgh Handedness Inventory.¹⁹ The left-handed group (group I) included 79 and the right-handed group (group II) 409 persons.

Evaluation of clinical oral conditions and oral-hygiene performance

A dental examination was performed in a dental chair using a standard operating light, an explorer, a periodontal probe, and a mouth mirror. All measurements were made

by a single clinician (Dr. Mehmet Özgöz) in order to achieve better standardization. Clinical oral indices, which are indicators of oral-hygiene performance, such as the plaque index (PI) and gingival index (GI), were evaluated. The PI is a classification of bacterial plaque accumulation on tooth surfaces. It is scored as follows; 0: no plaque on tooth surfaces; 1: tooth appears clean but plaque may be removed from its gingival third with a probe; 2: moderate accumulation of plaque deposits visible to the naked eye; and 3: heavy accumulation of soft material filling the niche between the gingival margin and tooth surface.²⁰ The GI is a classification of gingival inflammation that measures gingival bleeding. It is scored as follows; 0: normal gingiva, no inflammation, discoloration, or bleeding; 1: mild inflammation, a slight color change, and mild alteration of the gingival surface, but no bleeding on pressure; 2: moderate inflammation, erythema and swelling, bleeding on pressure; and 3: severe inflammation, erythema and swelling, tendency for spontaneous bleeding, and possibly ulceration.²¹ The brushing activity characteristics of the individuals such as the frequency of daily tooth-brushing (0: no brushing; 1: once a day; 2: twice a day; 3: 3 times a day), duration, and brushing technique were determined by an interview.

Measurement of tooth wear

The presence and type of cervical defects in each person were diagnosed using the tooth wear index (TWI),²² and this index was evaluated between and within groups. The TWI scores were 0: no change in the contour; 1: minimal loss of contour; 2: a defect of <1 mm in depth; 3: a defect of 1–2 mm in depth; and 4: a defect of >2 mm in depth, pulp exposure, or exposure of secondary dentine. Scores were determined by measuring the defect depth at the cervical tooth area with a Williams type periodontal probe, and mean values were recorded for each patient.

Statistical analysis

Statistical analysis was performed using SPSS 11.5 software for Windows (SPSS Inc., Chicago, IL, USA). Scores of brushing habits and clinical oral conditions of subjects were determined by a one-way analysis of variance (ANOVA) and a multiple-range least significant difference (LSD) test between and within groups. Correlative analyses among TWI scores, clinical oral conditions, and tooth-brushing scores were carried out using Spearman's rank correlation.

Results

According to hand preference, the total percent of right-handed individuals was 84%, and left-handed was 16% in the

Table 1 Demographic details and clinical variables of subjects.

	Group I (left-handed)	Group II (right-handed)	P value (group I vs. II)
Cervical defect (CD-n)			
Male			
CD+	11	71	—
CD-	31	122	—
Total	42	193	—
Female			
CD+	15	98	—
CD-	22	118	—
Total	37	216	—
Age (year)			
Male	36.3 ± 4.8	34.3 ± 3.7	0.311
Female	32.6 ± 3.5	31.8 ± 3.3	0.226
Total	33.7 ± 4.1	32.8 ± 3.4	0.277
Daily tooth-brushing (sessions/d)	1.36 ± 0.68	1.22 ± 0.63	0.394
Plaque index	1.47 ± 0.48	1.64 ± 0.53	0.193
Gingival index	1.26 ± 0.37	1.53 ± 0.47	0.171
Tooth wear index	1.78 ± 0.56	1.66 ± 0.55	0.122

Analysis of variance and a post-hoc LSD test were used.

Statistical significance at the 0.05 level between and within groups.

CD+, subjects with cervical defects; CD-, subjects with no cervical defects.

study population. Table 1 shows the numerical (*n*) distribution and clinical variables of subjects in terms of gender, age, and hand preference. No statistically significant differences were found between groups I and II with respect to daily tooth-brushing frequency ($P = 0.39$). On comparing the PI and GI, it was found that left-handed subjects had better oral-hygiene conditions than right-handers, but this was not statistically significant ($P = 0.19$ and $P = 0.17$, respectively). However, the mean TWI scores were higher in the left-handed group than the right-handed group, but this was not statistically significant ($P = 0.12$). The distribution of subjects according

to frequency, duration, and techniques of daily tooth-brushing in the left- and right-handed groups are presented in Table 2. It was found that there were statistically significant differences between men and women according to the clinical oral indices and brushing habits ($P < 0.01$) (Table 3). TWI scores were also statistically higher in women than men ($P < 0.01$). The relationship between brushing habits and TWI scores of subjects in terms of hand preference are given in Table 4. The mean TWI scores were statistically higher in subjects who used a horizontal brushing method than subjects who used a vertical method ($P < 0.01$). It was also

Table 2 Distribution of subjects according to the technique, frequency, and duration of daily tooth-brushing.

	Group I Left-handed (<i>n</i> = 79)		Group II Right-handed (<i>n</i> = 409)	
	Male	Female	Male	Female
Technique				
Horizontal	29	25	98	113
Vertical	13	12	95	103
Total	42	37	193	216
Frequency				
Once a day	23	19	93	103
Two or 3 times a day	10	10	75	77
More than 3 times a day	9	8	25	36
Total	42	37	193	216
Duration				
Less than 1 min	27	11	101	97
Between 1 and 3 min	10	17	81	109
More than 3 min	5	9	11	10
Total	42	37	193	216

Table 3 Differences between men and women according to oral-hygiene practices and clinical oral conditions.

	Male	Female	P value (male vs. female)
Daily tooth-brushing	0.88 ± 0.57	1.85 ± 0.99	0.0082
Plaque index	1.93 ± 0.51	0.90 ± 0.24	0.0048
Gingival index	1.77 ± 0.46	0.85 ± 0.19	0.0059
Tooth wear index	1.32 ± 0.36	1.97 ± 0.49	0.0073

[†]P < 0.01 significant difference.

seen that the grade of cervical abrasion was statistically higher in subjects with a higher frequency and longer duration of brushing habits in both groups ($P < 0.01$). Statistically significant correlations were found between the clinical oral scores (TWI, PI, and GI) and the duration and frequency of tooth-brushing habits for both groups ($P < 0.01$) (Table 5).

Discussion

Cervical tooth abrasion is the pathologic wearing of teeth as a result of abnormal processes, habits, or use of abrasive substances. Abrasion at the dental cervix can occur because of faulty tooth-brushing habits, abrasive toothpastes, hard toothbrushes, occlusal stress, and non-bacterial chemical dissolution.^{2,3} In many cases, faulty tooth-brushing causes tooth wear together with gingival recession in the cervical area.^{17,18,23,24} Even though brushing is an important procedure to protect against dental and periodontal diseases, people's regular tooth-brushing habits may sometimes damage the gingiva, dentine, and enamel due to improper brushing techniques. Hand skill and motivation are important factors in proper brushing activities.^{25,26} Because tooth-brushing is not a simple procedure and requires adequate manipulation and proficiency, it is known that people with improper brushing habits cannot achieve a sufficient oral-hygiene performance. Coren and Porac¹² reported that there was a significant association between hand skill and handedness. It was reported that left- and right-handers exhibit fundamental differences in measures of preference and proficiency.¹⁹ Individual hand performance was assessed using a dot-filling test, and

a high correlation was found between performance and preference measures.²⁷ Other studies on handedness showed that there was little difference in motor control, or performance on visio-spatial tasks, between left- and right-handed individuals.^{28,29} Although the effects of brushing habits on cervical tooth wear were previously investigated, relationships between handedness and tooth-brushing abrasion were not evaluated. A significant correlation was found between handedness and cognitive abilities and proficiency.^{12–16} So, in this study, it was thought that there might be an association between handedness and tooth-brushing-related cervical tooth defects depending on improper tooth-brushing.

In this study, we investigated the relationship between tooth-brushing-related cervical dental abrasion and handedness in terms of gender and brushing habits in left- and right-handed individuals. It was reported in previous studies that approximately 9–15% of people are left-handed in the entire population of Turkey.^{30–32} In this study, the percentage of the left-handed participants was 16%, and confirms those results. Previously, it was found that women had better oral-hygiene conditions than men, and this was statistically significant.³³ The results of this study (PI and GI scores) also confirmed that women had better oral hygiene than men in both the right- and left-handed groups (Table 3). Tezel et al.¹¹ stated that this might be a result of the fact that women care more about oral hygiene than do men. However, in this research, females exhibited higher TWI scores than males in both groups, which was statistically significant ($P < 0.01$) (Table 3). These differences between males and females may be related to long-term exposure to faulty brushing in the cervical dental area.

Table 4 Relationships between brushing habits and the mean tooth wear index (TWI) scores in right- and left-handed groups.

	TWI (mm, $\mu\text{m} \pm \text{SD}$)		P value (group I vs. II)
	(Group I)	(Group II)	
<i>Technique</i>			
Horizontal	1.96 ± 0.57*	1.75 ± 0.51*	0.0043
Vertical	0.34 ± 0.12	0.28 ± 0.11	0.0076
<i>Frequency</i>			
Once a day	0.73 ± 0.19 [‡]	0.58 ± 0.14 [‡]	0.0065
Two or 3 times a day	1.30 ± 0.46 [¶]	1.12 ± 0.43 [¶]	0.0048
More than 3 times a day	2.20 ± 0.63	2.06 ± 0.59	0.0024
<i>Duration</i>			
Less than 1 min	0.59 ± 0.17 [®]	0.48 ± 0.13 [®]	0.0068
Between 1 and 3 min	1.26 ± 0.46 ^{¶¶}	1.09 ± 0.44 ^{¶¶}	0.0052
More than 3 min	2.41 ± 0.66	2.27 ± 0.61	0.0019

Different symbols on the same line indicate a statistical significance at the 0.01 level between and within groups.

Table 5 Relationship between clinical oral scores and brushing habits of subjects.

	PI	GI	TWI
PI	—	—	—
GI	0.821*	—	—
TWI	-0.461*	-0.570*	—
Duration of brushing	-0.810*	-0.602*	0.512*
Frequency of brushing	-0.897*	-0.611*	0.493*

*Correlation was significant at the 0.01 level (by Spearman's rank correlation).
PI, plaque index; GI, gingival index; TWI, tooth wear index.

Cervical defects can be further characterized according to depth and size.³⁴ Experimental investigations showed that a cross brushing technique produces V-shaped grooves,³⁵ while vertical brushing tends to produce U-shaped notches.³⁶ The results of this study confirmed that a horizontal brushing method caused statistically higher abrasion than vertical brushing in both groups ($P < 0.01$) (Table 4). Checchi et al.¹⁸ reported that increased brushing duration and frequency caused cervical defects such as gingival recession and tooth wear. The data obtained from this study also confirmed that the amount of cervical defects was statistically higher in subjects with a higher frequency and longer duration of brushing habits in both the left- and right-handed groups ($P < 0.01$) (Table 4).

Several studies which investigated the effects of handedness on the oral-hygiene status suggested that left-handers have better oral conditions, but this finding was not statistically significant.^{5,25} Our results also confirmed those findings (Table 1). In a comparison of groups I and II, the mean TWI scores were higher in left-handers compared to right-handers, but this was not statistically significant ($P = 0.12$).

This is the first report investigating the effects of handedness on tooth-brushing-related dental abrasion. No statistically significant relationship was found between hand preference and tooth-brushing abrasion in this study. However, the effects of brushing habits on tooth abrasion were statistically significant. Therefore, dental practitioners should instruct patients in proper brushing techniques to prevent severe cervical defects. Further neurological studies that investigate the cognitive abilities and neuromuscular factors of left- and right-handed individuals are needed to better understand the effects of handedness on cervical tooth defects and oral-hygiene performance.

Conflict of interest and source of funding statement

We declare no conflict of interests.

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