Original Article

Can text messages encourage flossing among orthodontic patients?

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ABSTRACT

Objectives: To assess the extent to which text messages on WhatsApp play a role in patient awareness of the importance of proper oral hygiene and flossing on a daily basis and to test the null hypothesis that daily text messages do not influence the flossing habits of orthodontics patients.

Materials and Methods: Forty-four patients wearing fixed orthodontic appliances with a mean age of 14.3 years participated in the study. Patients (male and female) were randomly assigned to two groups (n = 22): group 1, text messages sent via WhatsApp daily during the study period, and group 2 (control), no text messages received. Plaque index, gingival bleeding index, and halitosis were assessed at baseline and after 30 days. The results were analyzed and subjected to normality test, McNemar test, Fisher exact test, Mann-Whitney test, and Wilcoxon signed-rank test.

Results: There was a significant influence on flossing habits ($P < .05$) and a significant reduction in plaque and gingival bleeding indices in group 1 ($P < .05$). Group 1 had a significant reduction in halitosis ($P < .05$).

Conclusions: Daily text messages seem to influence patient awareness of the importance of proper oral hygiene and flossing. The null hypothesis was rejected because those patients who received text messages every day changed their flossing habits. (*Angle Orthod.* 2021;91:650–655.)

KEY WORDS: Oral hygiene; Orthodontics; Home care; Patients

INTRODUCTION

Wearing orthodontic appliances leads to the accumulation of biofilm, which hinders oral hygiene and gives rise to new retentive sites that predispose patients to bacterial colonization and multiplication[1] with a significant increase in the number of cariogenic bacteria such as *Streptococcus mutans* and *Lactobacillus* sp.[2] The resulting gingival inflammation provides environmental conditions that are particularly favorable for the growth of periodontal pathogens including *Tannerella forsythia*, *Campylobacter reto*, *Prevotella nigrescens*, *Porphyromonas gengivalis*, and *Fusobacterium*.[3] Dental biofilm formation is two or three times higher in orthodontic patients than in nonorthodontic patients,[4] leading to gingivitis, white spot lesions, and carious lesions.[5]

Enamel demineralization is a significant risk associated with orthodontic treatment when oral hygiene is poor. The prevention of demineralization during orthodontic treatment poses a great challenge, despite recent breakthroughs in caries prevention. The development of white spot lesions is attributed to prolonged buildup of biofilm around the brackets.[6]

Constant gingival inflammation has deleterious effects on the periodontium, including gingival recession, hyperplasia, and subsequent periodontal disease.[7] Efficient biofilm removal and proper compliance with oral hygiene have been constant concerns among orthodontists. Hygiene is challenging for a significant

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percentage of orthodontic patients, and many of them suffer the adverse effects of poor oral hygiene during treatment (e.g., halitosis).[8] Halitosis has a multifactorial etiology, and biofilm control is paramount to treatment success.[9]

Appropriate oral hygiene requires detailed and clear instructions given by professionals, proper tools, and patient motivation.[10] Text messaging in health care has produced satisfactory outcomes in both nursing and medicine applications.[11] Communication is key to a successful orthodontic treatment,[12] and it is essential that the patient be part of his or her own treatment.[12]

Currently, social media have become increasingly important, and WhatsApp, a cross-platform mobile instant messaging technology, has taken on added importance in this case, allowing users to exchange messages in real time.[13] Social media platforms such as WhatsApp bring patients and professionals closer together on a daily basis and can also encourage patients to perform greater self-care. Therefore, this study aimed to assess the extent to which text messages influence patient awareness of the importance of flossing every day and to test the null hypothesis that daily text messages do not affect patients' flossing habits.

MATERIALS AND METHODS

Ethical Aspects and Sampling

This was an observational randomized clinical trial with orthodontic patients wearing fixed appliances. The study was approved by the Research Ethics Committee of Centro Universitário da Fundação Hermínio Ometto (CAAE: 12358219.0.0000.5385). All phases of the study were developed in compliance with the ethical standards established by the National Health Council of Brazil. The patients and legal guardians interested in participating in the study received all the necessary information and explanation about their participation. A free informed consent form was signed, and children and adolescents signed an assent form.

Sample size was previously calculated with a power of at least 0.80 and a significance level of 5%, which required 22 participants in each group (11 girls and 11 boys).[14] The sample comprised 44 patients with a mean age of 14.3 years, with a standard deviation of 2.6 years.[15] All patients were from the same private dental practice and were assigned to two groups ($n = 22$): group 1 (test) patients who received text messages, and group 2 (control), patients who did not receive text messages.

Patients wearing fixed orthodontic appliances on the permanent teeth (except on the third molars) were selected. All participants used WhatsApp on their cell phones. Patients with dentures, dental implants, or syndromes; those who had undergone orthognathic surgery; smokers; those on antibiotics or on any other drug taken on a regular basis; or those who refused to sign the free informed consent form were excluded from the sample.

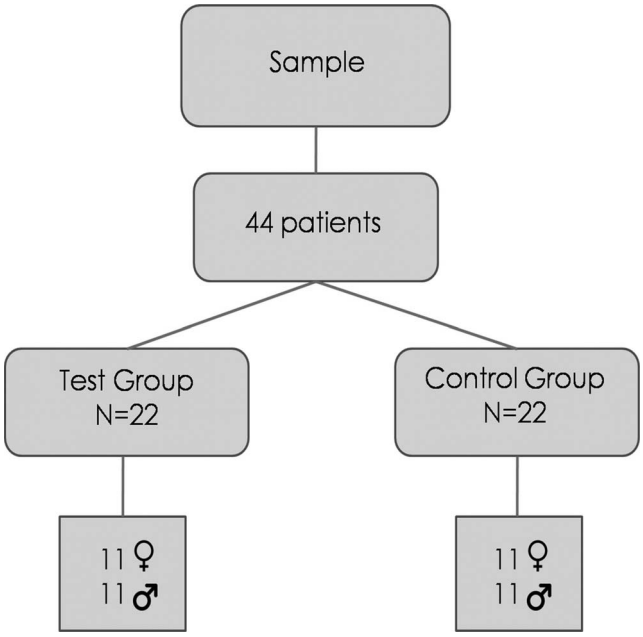

Figure 1. Study design flowchart.

Assessment of Halitosis and Toothbrushing and Flossing Frequencies

All patients were clinically assessed for plaque index (PI), gingival bleeding index (GBI), and halitosis at baseline (T0) and at the end of the study after 30 days (T30).[14]

All participants received prophylaxis at baseline; therefore, their PI = 0. In addition, they received instructions on toothbrushing and flossing.[15] All participants were given an oral hygiene kit containing a toothbrush, dental floss, and floss threader. Group 1 received daily motivational text messages via WhatsApp.[13] The frequencies of toothbrushing and flossing were recorded.[16] The flowchart in Figure 1 shows the study design.

Visible PI

Biofilm was observed without the use of dyes or optical instruments and was recorded in the upper and lower anterior sextants, according to Attin's orthodontic PI.[17] The index classifies the scores as 0, no visible plaque; 1, moderate buildup on surfaces lateral to the brackets; 2, moderate buildup on surfaces lateral and cervical to the brackets; 3, one-third of the gingival surface for support covered with plaque.

Table 1. Text Messages About Flossing Sent to Group 1

Text Messages
1. "Have you flossed today? Flossing every day helps keep bad breath away!"
2. "The week's just getting started, don't forget to floss every day! Not flossing increases your chances of having inflamed gums."
3. "For complete oral hygiene, you should floss every day."
4. "Have you brushed your teeth today? Don't forget to floss!"
5. "Good health begins with a healthy mouth, look after your health by flossing regularly."
6. "Do not forget: your treatment should be maintained every single day with proper toothbrushing and flossing."
7. "Do not forget! Flossing is important for maintaining your oral health."

The index was calculated using the following formula[17]: index = (sum of plaque scores × 100)/(3 × number of teeth examined), which could result in (1) <20%, excellent oral hygiene; (2) 20–39%, good oral hygiene; (3) 40–69%, moderate oral hygiene; (4) 70–100%, poor oral hygiene.

Gingival Bleeding Index

The bleeding index dichotomously assessed the presence or absence of bleeding from the selected teeth. A graduated World Health Organization probe was introduced smoothly 1 mm on the gingival margin of all teeth of the upper and lower anterior sextant using the distobuccal papilla, the buccal margin, the mesiobuccal papilla, and the lingual margin as references. The index was calculated by the percentage of bleeding surfaces (GBI%). This parameter was obtained by the sum of the number of bleeding surfaces divided by the total number of examined surfaces multiplied by 100.[18]

Assessment of Halitosis

The HC-212S Fitscan breath tester (Breath Checker, Tanita, Arlington Heights, Ill) was used to analyze the air exhaled by the patient using semiconductor technology for the measurement of volatile sulfur compounds and hydrocarbon gases, allowing breath analysis in 5 seconds.[19] The breath tester presented the results in six categories from nonexistent to severe.[20]

Toothbrushing and Flossing Frequencies

The patients were assessed for toothbrushing frequency at baseline using questions about whether they brushed their teeth once, twice, or three times a day. Flossing was assessed dichotomously regarding the daily use of dental floss (yes or no). Assessments were made at baseline and after 30 days.

Text Message About Flossing

Group 1 received private text messages on a daily basis for 30 days sent via WhatsApp (Santa Clara, Calif), always at the same time (at night), before the last toothbrushing.[14] Receipt of the message was confirmed by the application. All patients from group 1 had their names and cell phone numbers registered in a database to check who received the messages. To raise the patients' boredom threshold and to prevent possible withdrawals, six different messages were created and used in alternating order,[21] as shown in Table 1. After that, no text messages were sent, and the results were analyzed.

Data Analysis

Descriptive analysis was initially used with the estimation of frequencies, percentages, means, standard deviations, medians, minima, and maxima. McNemar test was used to assess toothbrushing and flossing frequencies at day 1 and after 30 days. Fisher exact test was used to compare group 1 and group 2 regarding changes in toothbrushing and flossing frequencies. The Mann-Whitney test was used to compare the groups with regard to PI, GBI, and halitosis scores, whereas the Wilcoxon signed-rank test was used to compare the same variables between the two time periods. The significance level was set at 5% (R Foundation for Statistical Computing, Vienna, Austria, 2019).

RESULTS

The mean age of the patients was 14.3 years, with a standard deviation of 2.6 years; 50% were female, and 50% were male. Patients who received text messages after 30 days increased their toothbrushing frequency to two or three times a day, but no statistical significance was observed ($P > .05$) when compared with the control group (Table 2; Figure 2).

Flossing increased in both groups. In group 1, the flossing frequency increased by 59.1% ($P < .001$) after 30 days, showing a statistically significant difference from the control group (group 2; $P > .05$). Group 2 showed a 31.8% increase in flossing frequency ($P < .03$; Table 2; Figure 2).

Table 3 shows the PI, GBI, and halitosis scores. Note that PI and GBI significantly decreased over time in both groups ($P < .05$). In group 1, the halitosis score decreased significantly ($P < .05$).

DISCUSSION

Oral hygiene must be followed by patients during orthodontic treatment, because it may affect treatment quality and length.[14] Adolescents are part of a

Table 2. Toothbrushing and Flossing Frequencies (%) as a Function of Text Messaging via WhatsApp

		30 Days			
		No Text Messaging		Text Messaging	
		Toothbrushing			
Variable	Baseline	Twice	Three Times	Twice	Three Times
Toothbrushing Frequency	Twice	8 (36.4%)	2 (9.1%)	2 (9.1%)	1 (4.5%)
	Three times	0 (0.0%)	12 (54.5%)	0 (0.0%)	19 (86.4%)
P value		0.1573		0.3173	
		Flossing			
		No	Yes	No	Yes
Flossing	No	6 (27.3%)	7 (31.8%)	3 (13.6%)	13 (59.1%)
	Yes	1 (4.5%)	8 (36.4%)	1 (4.5%)	5 (22.7%)
P value		0.0339		0.0013	

population that is not very concerned with oral hygiene,[22] and they account for most of the orthodontic patients.[18] There is a rapid deterioration of oral hygiene after initial bonding of orthodontic appliances, as fixed appliances predispose to biofilm accumulation and development of gingivitis.[15] Based on these assumptions, the aim of the present study was to assess how text messages could influence adolescents' awareness of the importance of flossing. The null hypothesis was rejected as daily text messages altered the patients' flossing behavior.

Gingival hyperplasia, as the result of a local inflammatory process, further complicates the patient's capacity to remove biofilm from dental surfaces. Although these effects may be temporary, some patients may develop serious conditions such as chronic hyperplasia, caries, and white spot lesions after appliance removal. These conditions might require invasive intervention after orthodontic treatment.[22] It is imperative that patients be instructed at the dental clinic about appropriate oral hygiene practices both at the beginning and at the end of orthodontic treatment, thereby minimizing these effects.[23] Therefore, the rationale behind this study rested on assessing whether text messages could encourage adolescents to follow better toothbrushing and flossing practices.

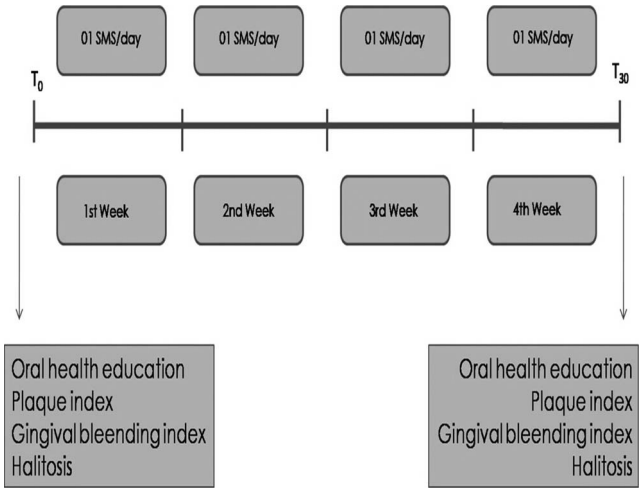

Figure 2. Distribution of toothbrushing frequency (A) and flossing frequency (B) as a function of time and receipt of text messages via WhatsApp. Significance: * $P < .03$; ** $P < .001$.

The means for PI, GBI, pocket probing depth, and clinical attachment loss are significantly higher among orthodontic patients. In the present study, the adolescents who received text messages tended to increase their toothbrushing frequency, maintaining this behavior for 30 days. However, this motivational tool was not able to assess toothbrushing habits decisively because the text messages were targeted at the flossing habit. There was a significant change in flossing frequency in both groups. Patients who received text messages showed better compliance with flossing habits. Orthodontic patients who floss regularly have better gingival health.[16]

Both groups had significantly lower PI and GBI as, in general, the patients improved their oral hygiene behavior and care after the initial instructions, especially with regard to flossing. This demonstrated that good professional conduct and guidance at the dental office may be enough for patients to improve their oral health status. Also, text messages are efficient in maintaining patients' good behavior toward, and collaboration with, oral hygiene practices during orthodontic treatment. The combination of positive reinforcement (Hawthorne effect) at each treatment session with text messaging on a daily basis was a valuable and modern tool for patient motivation.

The use of smartphones led to new communication tools with the use of downloaded apps.[24] Several studies have also demonstrated that applications designed to help with toothbrushing efficiently improved the oral health of orthodontic patients.[25] Other services, such as short message service,[14] phone

Table 3. Median (Minimum and Maximum) of Plaque Index, Gingival Bleeding Index, and Halitosis Score as a Function of Time and Receipt of Text Messages via WhatsApp

Variable	Group	Time Period		*P* Value
		Baseline	30 Days	
Plaque index	No text messaging	2.5 (1.0–4.0)	2.0 (1.0–4.0)	.0281
	With text messaging	3.0 (1.0–4.0)	2.0 (1.0–3.0)	.0059
P value		.6472	.4597	
Gingival bleeding index	No text messaging	3.0 (2.0–4.0)	2.0 (1.0–4.0)	.0033
	With text messaging	3.0 (1.0–4.0)	2.0 (1.0–3.0)	.0222
P value		.6727	.6985	
Halitosis score	No text messaging	2.0 (0.0–4.0)	2.0 (0.0–4.0)	.2863
	With text messaging	3.0 (1.0–5.0)	3.0 (1.0–4.0)	.0414
P value		.0086	.0956	

calls,[15] chat apps,[24] or notifications[26] may contribute toward improving the oral hygiene of adolescent patients.[27] In this study, daily text messaging via WhatsApp was chosen.

Hence, social media have changed several aspects of the activities of daily living and have become essential tools in everyday life.[28] According to a recent study conducted in Kuwait, 99% of individuals used social media and 50% of them used WhatsApp, an application for instant messages over the internet that allows communication through the sharing of text/voice messages, images, music, and videos.[29]

The use of WhatsApp could be an alternative for young orthodontic patients with poor oral hygiene who do not follow oral health recommendations. The current use of smartphones offers new opportunities for the development of interventions in this direction.[30] The text messages sent via WhatsApp in this study served to encourage patients to follow flossing and oral hygiene practices and to guide them throughout the process.

Studies have shown that 90% of the cases of halitosis in adults and children are closely related to poor oral hygiene, salivary gland disorders, periodontal disease, and dental caries. The actual prevalence of halitosis is unknown because of the heterogeneous nature of studies and to subjective perceptions.[31] This study revealed a significant reduction in halitosis among patients who received the text messages, which might have been an additional motivational strategy to improve compliance with oral hygiene habits since halitosis can be embarrassing and affects patients' communication and social life.[32]

Therefore, WhatsApp can be used as a communication tool in educational and clinical settings[13] and can be a potential avenue for clarifying doubts and encouraging treatment compliance. Text messages have become the major means of communication among adolescents,[8] and in this study, they proved to be an important tool for improving the oral hygiene of these patients.

CONCLUSION

- Text messages via WhatsApp sent to adolescent patients on a daily basis seem to influence their awareness of the importance of maintaining good oral hygiene, making them eventually increase their flossing frequency.

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