Cumhuriyet Dental Journal, 28(2): 132-140, 2025
DOI: https://doi.org/10.7126/cumudj.1572415

Cumhuriyet Dental Journal

| cdj.cumhuriyet.edu.tr | Founded: 1998 Available online, ISSN: 1302-5805 Publisher: Sivas Cumhuriyet Üniversitesi

Evaluation of the Effects of a Mobile Application on Oral Hygiene Motivation and Compliance with Fixed Orthodontic Patients

Hikmet Guliyev[1,a], Barış Başer[1,b,*]

[1]*Department of Orthodontics, Faculty of Dentistry, Karadeniz Technical University, Trabzon, Turkey*
**Corresponding author*

Research Article

History

Received: 23/10/2024
Accepted: 22/03/2025

ABSTRACT

Objectives: The aim of this study is to evaluate the effects of a uniquely developed mobile app on oral hygiene motivation and treatment compliance in patients undergoing fixed orthodontic treatment in comparison to traditional oral hygiene instructions.

Materials and Methods: In this prospective, controlled clinical trial, 50 orthodontic patients having fixed treatment were equally divided into two groups: a mobile app (e-tel (ortomobil)) and a control group. The control group received only traditional communication, consisting of verbal and written instructions at the start of treatment. Patients assigned to the mobile app group were provided with the ability to reschedule their appointments via the app, engage in direct chat with their orthodontist, and receive periodic notifications to remind them of oral hygiene motivation in addition to standardized hygiene instructions. Periodontal scores were obtained at 4 week intervals during three appointments (T1-T3) using the gingival index (GI), bleeding index (BI), and planimetric plaque quantification (PI) on photographs. Student's t-test and Mann Whitney U test were used for intergroup comparisons and evaluation of repeated measurements ($p<0.05$).

Results: GI and BI scores were significantly lower in the mobil app group than in the control group at T3 ($p =0.001$, $p < 0.01$). The PI scores did not show a statistically significant result at the end of the third month ($p> 0.05$). The use of mobile app increased patients' compliance.

Conclusions: A uniquely developed mobile app effectively maintained the oral hygiene motivation of patients undergoing fixed orthodontic treatment and contributed to an improvement in their treatment compliance.

Keywords: Orthodontic treatment, oral hygiene motivation, smartphone application.

Sabit Ortodontik Tedavi Gören Hastalarda Bir Mobil Uygulamanın Ağız Hijyeni Motivasyonu ve Uyum Üzerindeki Etkilerinin Değerlendirilmesi

Araştırma Makalesi

Süreç

Geliş: 23/10/2024
Kabul: 22/03/2025

ÖZET

Amaç: Bu çalışmanın amacı, özgün olarak geliştirilen bir mobil uygulamanın sabit ortodontik tedavi gören hastalarda ağız hijyeni motivasyonu ve tedavi uyumu üzerindeki etkilerini geleneksel ağız hijyeni talimatlarıyla karşılaştırarak değerlendirmektir.

Materyal ve Metot: Bu prospektif, kontrollü klinik çalışmada, 50 sabit ortodontik tedavi hastası eşit şekilde mobil uygulama (Ortomobil (e-tel)) ve kontrol grubu olmak üzere ikiye ayrıldı. Kontrol grubu, tedavinin başlangıcında sadece sözlü ve yazılı talimatlardan oluşan geleneksel iletişim aldı. Mobil uygulama grubuna atanan hastalara, randevularını uygulama üzerinden yeniden planlama, ortodontistleriyle doğrudan iletişimde olabilme ve standart hijyen talimatlarına ek olarak ağız hijyeni motivasyonunu belirli aralıklarla hatırlatan bildirimler alma imkanı sağlandı. Periodontal skorlar, 4 haftalık aralıklarla, ardışık üç randevu (T1-T3) sırasında gingival indeks (GI), kanama indeksi (BI) ve fotoğraflardan elde edilen planimetrik plak miktarı (PI) ölçülerek elde edildi. Gruplar arası karşılaştırmalar ve tekrarlanan ölçümlerin değerlendirilmesi için Student's t-testi ve Mann Whitney U testi kullanıldı ($p<0,05$).

Bulgular: Mobil uygulama grubundaki GI ve BI skorları, kontrol grubuna göre T3'te ($p = 0,001$, $p < 0,01$) anlamlı şekilde daha düşük bulundu. Üçüncü ayın sonunda PI skorları istatistiksel olarak anlamlı bir sonuç göstermedi ($p > 0,05$). Mobil uygulamanın kullanımı hastaların tedavi uyumunu artırdı.

Sonuç: Özgün olarak geliştirilen bir mobil uygulama, sabit ortodontik tedavi gören hastaların ağız hijyeni motivasyonunu etkili bir şekilde sürdürebilmesine ve tedavi uyumlarının artmasına katkıda bulundu.

Anahtar Kelimeler: Ortodontik tedavi, ağız hijyeni motivasyonu, akıllı telefon uygulaması.

[a] *hikmat.guliev@gmail.com* *0000-0003-0246-3343* [b] *baris.baser@ktu.edu.tr* *0000-0002-3052-9023*

How to Cite: Guliyev H, Başer B. (2025). Evaluation of the Effects of a Mobile Application on Oral Hygiene Motivation and Compliance with Fixed Orthodontic Patients. Cumhuriyet Dental Journal, 28(2): 132-140.

Introduction

Maintaining proper oral hygiene is essential for patients throughout the orthodontic treatment process.[1] Oral hygiene can rapidly deteriorate immediately after bracket application.[2] Compliance with hygiene protocols tends to decline to its lowest levels during long-term orthodontic treatment, highlighting the difficulty and importance of maintaining consistent and adequate oral hygiene throughout the treatment period.[3] The most critical factor preventing gingivitis and pathological hard tissue loss is the control of microbial plaque.[4] Both mechanical and chemical approaches can be used to combat the formation of microbial plaque.[4] The use of interdental brushes and dental floss is a mechanical plaque control method; however, agents such as antiseptics, antibiotics, and enzymes that reduce plaque activity are used for chemical plaque control.[5]

Patient compliance, which is a crucial component of orthodontic treatment, is defined as regular attendance at appointments, adhering to oral hygiene instructions, using elastics and other orthodontic appliances correctly, and avoiding hard and sticky foods that can damage the brackets and orthodontic appliances.[6] When patient compliance, which is essential for successful treatment, is not achieved, treatment success is compromised.[7] Studies have shown that effective communication with patients promotes more successful treatment outcomes.[8-13] Patients' willingness to undergo treatment and effective dialogue with their parents are highlighted as significant factors that enhance patient compliance.[9,14]

The methods orthodontists use to communicate with patients are a crucial part of the information delivery process, as patients need to clearly understand what is expected of them to remain compliant and motivated during the treatment process.[11,15] Previous studies have shown that presenting information to orthodontic patients in a visual format can effectively enhance information retention.[16,17] In recent years, technological innovations have made dental health services more effective, faster, and comfortable.[18] Among these developments, teledentistry combines telecommunications and dental practices to facilitate the exchange of clinical information and images over long distances for dental consultations and treatment planning.[19] With technological advancements, new opportunities for teledentistry have emerged, reshaping existing business models and altering the dynamics of dental treatment services.[20] Teledentistry offers the ability to remotely monitor recorded data rapidly, enables simultaneous communication with multiple individuals, reduces hospital costs and patient waiting times, and contributes to lowering long-term treatment costs.[21] Marino et al. reported in their study on teleorthodontics that orthodontists could effectively assess the need for early orthodontic treatment in pediatric patients through digital methods via teleconsultation.[22] Among these innovative developments, smartphone applications offer various advantages, particularly for young patients undergoing fixed orthodontic treatment.[23] A 2019 study revealed that there were 612 mobile applications related to oral health, highlighting the high level of interest and need for maintaining oral health.[24] Another study reported that mobile health applications could be used as additional tools to manage periodontal inflammation and enhance oral health knowledge.[25]

Considering this information, this study aimed to examine the potential effects of a uniquely designed mobile application on oral hygiene motivation and behavioral changes in patients undergoing fixed orthodontic treatment.

Materials and Methods

This study included 50 patients aged ≥13 years who were scheduled at the Department of Orthodontics, Karadeniz Technical University Faculty of Dentistry. The sample size calculation was based on the study by Scheerman et al.[26] (alpha error = 0.05, beta error = 0.20, effect size = 0.55). All patients and their parents provided informed consent after receiving information on the purpose of the study. Ethical approval was obtained from the Karadeniz Technical University Ethics Committee (Date: December 30, 2021; Protocol no: 24237859-8).

The study included patients with Class 1 malocclusion who had mild-to-moderate crowding that did not require tooth extraction and who owned a smartphone. Patients requiring orthognathic surgery, those with any motor function disorder or physical or mental disability that would impede tooth brushing, patients with congenital tooth absence or missing teeth before treatment, patients with impacted teeth, patients with supernumerary teeth, and patients with tooth shape anomalies were excluded from the study.

Development of the Mobile Application

In this study, a smartphone application (Figure 1) named e-tel (Ortomobil) was developed and licensed in collaboration with a technology company (Turcasoft Software, Samsun, Turkey) to examine its effects on the oral hygiene motivation of the study group. This application, with distinct patient and orthodontist modules, allows written and visual messaging between the patient and orthodontist (Figure 2). Additionally, the application allows the patient or orthodontist to reschedule or cancel appointments. With additional software, the application allows for recording patient compliance with appointments, changes in periodontal values, and bracket detachment scores. The application ensures that data tracking remains confidential upon entering the identities of the orthodontists and patients. The mobile application was uploaded to digital markets (App Store and Google Play Store) and installed on the smartphones of the patients in the study group.

Figure 1. *Ortomobil application*

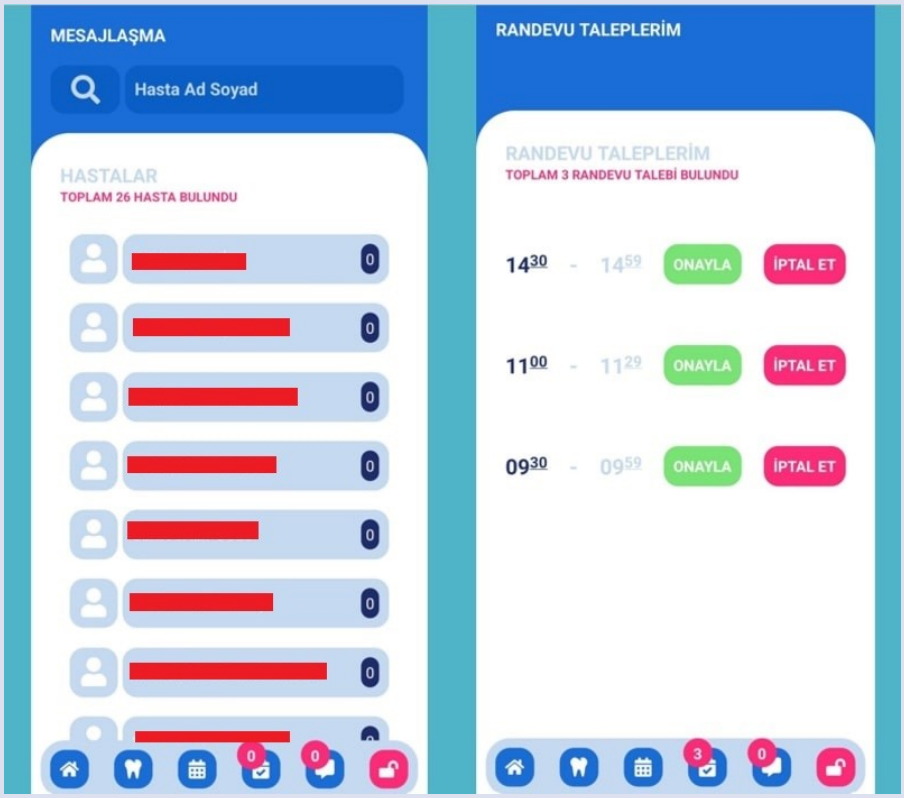

Figure 2. *Ortomobil interface*

All patients in the control group (n = 25) and the study group (n = 25) received 0.022 slot Roth system stainless steel brackets and tubes (Discovery® Smart; Dentaurum, Ispringen, Germany). The same bonding protocol and adhesive (3M Transbond XT) were used for all patients. After the bonding procedure, all participating patients were provided with oral hygiene instructions through videos and hands-on training using models, and it was explained that oral care should be performed at least twice a day. In addition to standard hands-on hygiene instructions, patients in the mobile application group (study group) received appointment reminder notifications, hygiene motivation reminders through visual aids, and direct messaging opportunities with the orthodontist through the mobile application. No additional motivational interventions were provided to patients in the control group beyond the standard instructions provided at the start of treatment.

After the removal of archwires during orthodontic control sessions held at 4-week intervals, changes in oral hygiene and the periodontal status of the teeth were assessed using the Bleeding Index (BI), Gingival Index (GI), and Plaque Index (PI).[27-29] Plaque staining was performed on teeth 12, 22, 13, 23, 33, and 43.[30] Measurements were performed by photographing the teeth and analyzing the images digitally using the Digimizer 6.3.0 (MedCalc Software Ltd., Belgium) software for planimetric analysis (Figure 3). The stained areas in the measurements were quantified in square millimetres and expressed as a percentage of the total tooth areas. The initial oral hygiene measurement was designated as T0, and sequential measurements were made during the first three orthodontic sessions (T1, T2, and T3). Data were recorded by a single researcher after each measurement.

To examine the effects of the mobile application on behavioral changes in patients between the study and control groups, a patient cooperation form [31] was developed, and the responses were recorded.

Statistical analyses were conducted using the *Statistical Package for the Social Sciences* (SPSS 27) software. Student's *t*-test and Mann–Whitney *U* test were used for intergroup comparisons. For intragroup comparisons of quantitative variables, repeated measures ANOVA and Friedman test were employed, whereas Bonferroni-corrected pairwise comparisons and Dunn test were used for evaluating binary comparisons. Pearson chi-squared test was used to compare qualitative data. A p-value <0.05 was considered statistically significant in all analyses.

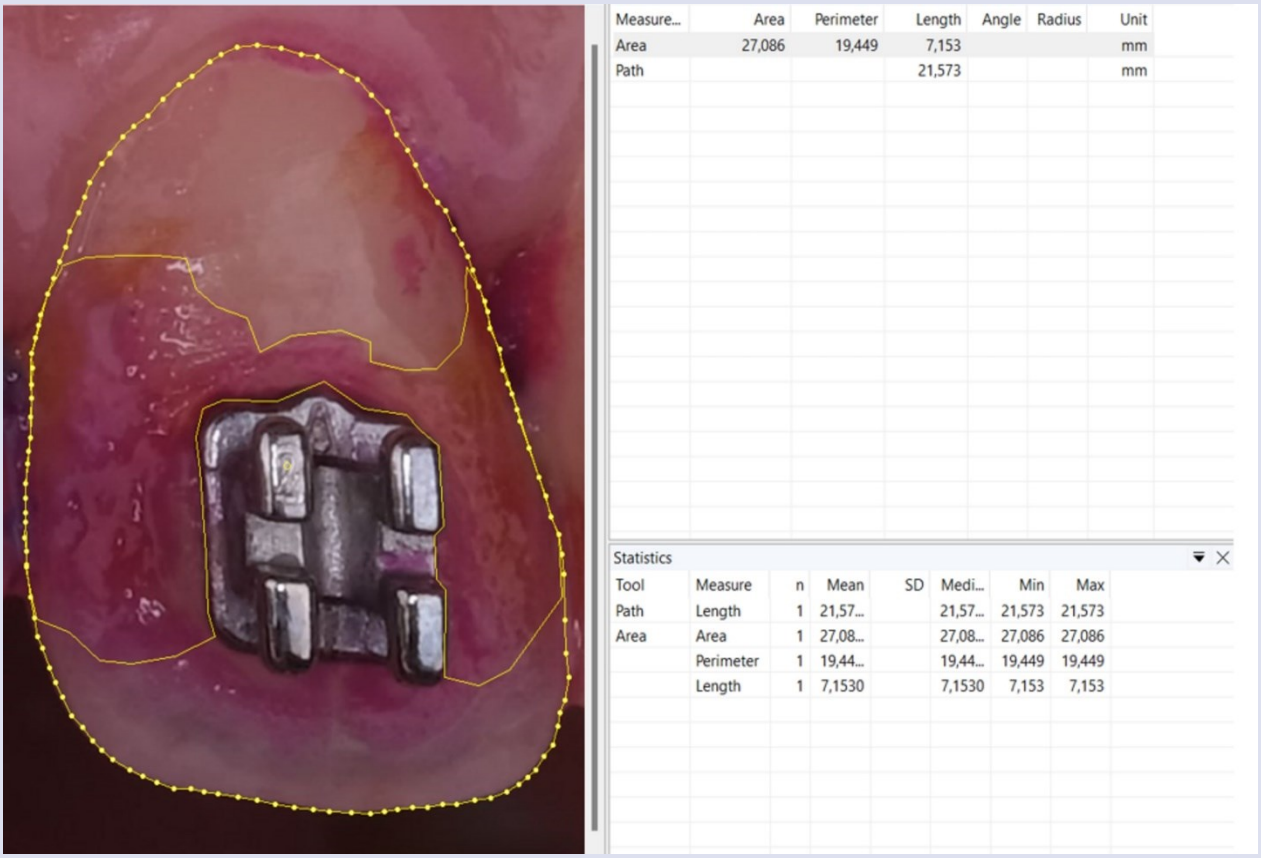

***Figure 3**: Digimizer software*

Results

The study was conducted with a total of 50 participants, consisting of 64% (n = 32) female and 36% (n = 18) male participants. The ages of the participants ranged from 13 to 21 years, with a mean age of 15.96 ± 1.73 years. The descriptive characteristics of the study and control groups are shown in Table 1.

According to the cooperation form, the scores for "Number of broken or damaged brackets noticed at patient appointments," did not show significant differences at all measurement periods in study and control groups ($p > 0.05$). The scores for "Patient adherence to appointments" did not show significant differences at T1 and T2 ($p > 0.05$), but at T3, the scores for the mobile application group were significantly lower ($p = 0.010$; $p < 0.05$). The scores for "Patient is enthusiastic about their treatment" did not show significant differences at T1 and T2 ($p > 0.05$), but at T3, the mobile application group also had significantly lower scores ($p = 0.009$; $p < 0.05$). The scores of patient cooperation form are presented in Table 2.

Upon analysing the study and control groups individually, significant increases in gingival index (GI) values were noted following three consecutive orthodontic sessions (T1–T3) ($p = 0.001$; $p < 0.01$). When comparing the study and control group patients, the GI values at T1 and T2 did not differ significantly ($p > 0.05$). However, the GI value for the study group at T3 was significantly lower than that of the control group ($p = 0.001$; $p < 0.01$). The mean GI values and a comparison of the groups are presented in Table 3.

Table 1. *Distribution of descriptive characteristics by groups*

		Group			Test Value
		Control	**Experimental**	**Total**	**p**
Age	Mean±Sd	15.64±1.50	16.28±1.90	15.96±1.73	t:-1.321
	Median (Min-Max)	16 (13-18)	16 (13-21)	16 (13-21)	[a]**0.193**
Gender	**Female**	15 (60.0)	17 (68.0)	32 (64.0)	χ^2:0.347
	Male	10 (40.0)	8 (32.0)	18 (36.0)	[b]**0.556**

[a]*Student-t Test* [b]*Pearson Chi-Square Test*

Table 2. *Statistical analyses of scores of the patient's cooperation*

			Group			
			Control (n=25)	**Experimental (n=25)**	**Total (n=50)**	***p***
Compliance to appointments	**T1**	*Mean±Sd*	2±0.87	1.8±0.71	1.9±0.79	Z:-0.760
		Median (Min-Max)	2 (1-4)	2 (1-3)	2 (1-4)	[a]***0.447***
	T2	*Mean±Sd*	1.8±0.71	1.64±0.57	1.72±0.64	Z:-0.713
		Median (Min-Max)	2 (1-4)	2 (1-3)	2 (1-4)	[a]***0.476***
	T3	*Mean±Sd*	2.84±0.69	2.28±0.79	2.56±0.79	Z:-2.592
		Median (Min-Max)	3 (1-4)	2 (1-4)	3 (1-4)	[a]***0.010****
Breakage of braces	**T1**	*Mean±Sd*	2.4±0.5	2.36±0.49	2.38±0.49	Z:-0.288
		Median (Min-Max)	2 (2-3)	2 (2-3)	2 (2-3)	[a]***0.773***
	T2	*Mean±Sd*	2.36±0.49	2.28±0.61	2.32±0.55	Z:-0.361
		Median (Min-Max)	2 (2-3)	2 (1-3)	2 (1-3)	[a]***0.718***
	T3	*Mean±Sd*	2.08±0.57	1.8±0.58	1.94±0.59	Z:-1.690
		Median (Min-Max)	2 (1-3)	2 (1-3)	2 (1-3)	[a]***0.091***
Attention to treatment	**T1**	*Mean±Sd*	1.6±0.5	1.52±0.51	1.56±0.5	Z:-0.564
		Median (Min-Max)	2 (1-2)	2 (1-2)	2 (1-2)	[a]***0.573***
	T2	*Mean±Sd*	1.92±0.86	1.8±0.65	1.86±0.76	Z:-0.337
		Median (Min-Max)	2 (1-4)	2 (1-3)	2 (1-4)	[a]***0.736***
	T3	*Mean±Sd*	2.88±0.67	2.4±0.5	2.64±0.63	Z:-2.597
		Median (Min-Max)	3 (2-4)	2 (2-3)	3 (2-4)	[a]***0.009****

[a]*Mann Whitney U Test* *$p<0.05$ **$p<0.01$

Table 3. *Comparison of gingival index (GI) values by groups*

			Group			
			Control (n=25)	**Experimental (n=25)**	**Total (n=50)**	***p***
Gingival Index	**T0**	*Mean±Sd*	0	0	0	-
		Median (Min-Max)				
	T1	*Mean±Sd*	0.88±0.23	0.95±0.4	0.92±0.32	t:-0.702
		Median (Min-Max)	0.9 (0.5-1.4)	1 (0.3-1.8)	1 (0.3-1.8)	***[a]0.487***
	T2	*Mean±Sd*	0.95±0.24	0.98±0.38	0.96±0.32	t:-0.233
		Median (Min-Max)	1 (0.5-1.4)	1 (0.4-1.9)	1 (0.4-1.9)	***[a]0.817***
	T3	*Mean±Sd*	1.76±0.19	1.28±0.3	1.52±0.35	t:6.664
		Median (Min-Max)	1.8 (1.4-2)	1.2 (0.9-2)	1.6 (0.9-2)	***[a]0.001****
			F:651.017	F:220.464		
		p	***[d]0.001****	***[d]0.001****		
		T0 - T1	0.88±0.23	0.95±0.40		t:-0.702
		p	***0.019****	***0.003****		***[a]0.487***
		T0 - T2	0.95±0.24	0.98±0.38		t:-0.233
		p	***0.001****	***0.001****		***[a]0.817***
		T0 - T3	1.76±0.19	1.28±0.30		t:6.664
		p	***0.001****	***0.001****		***[a]0.001****
		T1 - T2	0.07±0.05	0.03±0.06		Z:-2.305
		p	***0.129***	***0.835***		***[c]0.021****
		T1 - T3	0.87±0.23	0.33±0.18		t:9.349
		p	***0.001****	***0.001****		***[a]0.001****
		T2 - T3	0.80±0.24	0.30±0.16		t:8.800
		p	***0.019****	***0.011****		***[a]0.001****

[a]Student-t Test
[c]Mann Whitney U Test
[d]Friedman Test&post hoc Dunn test
**p<0.05 **p<0.01*

Table 4: *Comparison of bleeding index (BI) values by groups*

			Group			
			Control (n=25)	**Experimental (n=25)**	**Total (n=50)**	***p***
Bleeding Index	**T0**	*Mean±Sd*	0	0	0	-
		Median (Min-Max)				
	T1	*Mean±Sd*	0.26±0.12	0.3±0.14	0.28±0.13	Z:-0.824
		Median (Min-Max)	0.3 (0-0.4)	0.3 (0-0.5)	0.3 (0-0.5)	***[c]0.410***
	T2	*Mean±Sd*	0.44±0.11	0.37±0.16	0.4±0.14	t:1.847
		Median (Min-Max)	0.4 (0.2-0.7)	0.3 (0-0.8)	0.4 (0-0.8)	***[a]0.071***
	T3	*Mean±Sd*	0.65±0.12	0.4±0.18	0.53±0.2	t:5.930
		Median (Min-Max)	0.6 (0.5-1)	0.3 (0.2-1)	0.5 (0.2-1)	***[a]0.001****
			χ^2:72.024	χ^2:53.094		
		p	***[d]0.001****	***[d]0.001****		
		T0 - T1	0.26±0.12	0.3±0.14		Z:-0.824
		p	***0.051***	***0.001****		***[c]0.410***
		T0 - T2	0.44±0.11	0.37±0.16		t:1.847
		p	***0.001****	***0.001****		***[a]0.071***
		T0 - T3	0.65±0.12	0.4±0.18		t:5.930
		p	***0.001****	***0.001****		***[a]0.001****
		T1 - T2	0.18±0.12	0.07±0.15		Z:-2.776
		p	***0.037****	***0.331***		***[c]0.005****
		T1 - T3	0.40±0.16	0.10±0.17		Z:-4.867
		p	***0.001****	***0.026****		***[c]0.001****
		T2 - T3	0.22±0.15	0.03±0.11		Z:-4.213
		p	***0.051***	***1.000***		***[c]0.001****

[a]Student-t Test
[c]Mann Whitney U Test
[d]Friedman's Test&Post hoc Dunn test
**p<0.05 **p<0.01*

Table 5. *Comparison of Plaque Index (PI) values by group*

			Group			
			Control (n=25)	Experimental (n=25)	Total (n=50)	*p*
Plaque Index	**T0**	*Mean±Sd*	0	0	0	-
		Median (Min-Max)				
	T1	*Mean±Sd*	47.41±10.21	49.86±9	48.64±9.61	t:-0.899
		Median (Min-Max)	43.8 (33.2-65.9)	51.1 (33.5-67.3)	48.9 (33.2-67.3)	[a]***0.373***
	T2	*Mean±Sd*	48.17±10.14	50.66±8.97	49.41±9.56	t:-0.920
		Median (Min-Max)	44.8 (34-66.5)	51.8 (34.4-68.2)	49.7 (34-68.2)	[a]***0.362***
	T3	*Mean±Sd*	51.11±10.15	51.44±8.47	51.28±9.25	t:-0.125
		Median (Min-Max)	48.2 (36.3-69.3)	52.2 (36.3-69.9)	51.8 (36.3-69.9)	[a]***0.901***
	Total	*Mean±Sd*	283.17±24.82	275.45±23.74	279.31±24.35	t:1.124
		Median (Min-Max)	289.2 (228-321.3)	275.4 (231.3-311.6)	286.2 (228-321.3)	[a]***0.267***
			χ^2:73.848	χ^2:69.336		
		p	[d]***0.001****	[d]***0.001****		
		T0 - T1	47.41±10.21	49.86±9.00		t:-0.899
		p	***0.026****	***0.019****		[a]***0.373***
		T0 - T2	48.17±10.14	50.66±8.97		t:-0.920
		p	***0.001****	***0.001****		[a]***0.362***
		T0 - T3	51.11±10.15	51.44±8.47		t:-0.125
		p	***0.001****	***0.001****		[a]***0.901***
		T1 - T2	0.76±0.38	0.80±0.34		Z:-0.349
		p	***0.071***	***0.051***		[c]***0.727***
		T1 - T3	3.70±0.93	1.58±1.03		Z:-5.549
		p	***0.001****	***0.001****		[c]***0.001****
		T2 - T3	2.94±0.78	0.78±1.03		Z:-5.792
		p	***0.026****	***0.129***		[c]***0.001****

[a]*Student-t Test*
[c]*Mann Whitney U Test*
[d]*Friedman's Test&Post hoc Dunn test*

BI values showed significant increase in both groups after three orthodontic appointments (p = 0.001; p < 0.01). However, when comparing the study and control groups, no significant differences were observed in BI values during the first 2 months after the start of treatment (T1 and T2), similar to the GI values (p > 0.05). In contrast, the BI value for the study group at T3 (measurement during the third orthodontic session) was significantly lower than that of the control group (p = 0.001). The mean BI values and a comparison of the groups are presented in Table 4.

Plaque staining values also showed significant increase in both groups after three orthodontic sessions (p = 0.001; p < 0.01). When examining the study and control groups separately, the measurement values at T1, T2, and T3 did not significantly differ (p > 0.05). The mean plaque staining values and comparison of the groups are presented in Table 5.

Discussion

Technological advancements have made healthcare systems more accessible than ever before.[32] Significant developments and the rapid proliferation of smartphones in recent years have enabled mobile applications to provide comprehensive health information to a broader audience.[33] These applications have motivated users to improve their oral hygiene.[33] The primitive form of these technologies, the short message service (SMS), was initially tested on patients. SMS reminders significantly reduced periodontal scores at specific intervals for patients undergoing fixed orthodontic treatment.[1,34,35] In another study that examined the course of BI, Modified Gingival Index (MGI), PI, and white spot lesions over time, SMS reminders resulted in significantly lower average BI, MGI, and PI scores after approximately 5 months.[1] In contrast, previous studies have shown that providing audiovisual information to orthodontic patients via the internet significantly enhances their knowledge.[36] In the present study, considering the ages of patients undergoing orthodontic treatment, the usage habits of this generation, and the prevalence of smartphone use, a unique and user-friendly mobile application was designed and used instead of applications lacking visual elements like SMS.

Previous studies, reviews and meta-analysis have examined the effects of mobile applications (WhiteTeeth and WeChat), digital innovations and smartphone-based telemonitoring on the hygiene motivation of orthodontic patients.[26,37-43] Although these applications generally focus on oral hygiene motivation, the mobile application used in the present study offers a more interactive interface. This approach promotes periodontal motivation and facilitates appointment adherence, proper use of orthodontic appliances, and direct access in acute situations. In addition, while other applications typically offer chat rooms and networking services, the e-tel (Ortomobil) application allows individual use. This allows patients to feel more comfortable during treatment and avoids the secondary effects of group communication. Other applications in previous studies and the mobile application used in the present study showed that sending reminders to patients, communicating with them, and raising awareness during treatment increased knowledge

levels and improved or maintained periodontal values in patients undergoing fixed orthodontic treatment. The significant results obtained in this study can be attributed to the unique, multifaceted, and interactive mobile application interface.

In a study using the “Brush DJ” application, a mobile health technology to manage the frequency and duration of oral care in patients undergoing orthodontic treatment, significant reductions in GI and PI were observed at the start, fourth week, eighth week, and twelfth week of treatment compared with those using traditional methods.[29] In the present study, the decreases in the GI and BI values in the mobile application group observed at the third month of treatment were consistent with the results of this study.[29] When comparative findings were examined, no significant difference was found in the GI and BI values at T1 and T2 measurements. According to social psychology studies, it takes 2–3 months for a behavior to become a habit.[44] This may explain the effects of the mobile application on the GI and BI values after the second measurement. When the mobile application and standard oral hygiene education groups were analyzed separately, significant increases in plaque staining values were observed in both groups ($p = 0.001$; $p < 0.01$). A 2017 study reported that at least 354 applications related to orthodontics were registered in Android and Apple application stores.[45] Although these orthodontic applications have improved oral health, oral hygiene has not yet reached an optimal level, and patients’ plaque levels remain high after treatment.[26] In line with previous studies, plaque levels remained high in both groups in the present study.

Consistent with digital developments in orthodontics, a recent systematic review noted that social media is crucial in the dissemination of information on psychosocial factors related to orthodontic patients.[40] The data obtained from the patient cooperation forms evaluated in the present study showed that there were significant changes in “patient adherence with appointments” and “enthusiasm toward their treatment” at the end of 3 months. These results demonstrate that mobile applications can promote certain behavioral changes similar to social media applications.

In general dental practice, it is challenging for professional dentists to educate patients about the importance of oral hygiene.[38] Because esthetic concerns affect the appearance and function of orthodontic appliances, motivation and compliance during treatment are key to its success.[38] Therefore, educating patients about the benefits of treatment is crucial for successful orthodontic therapy.[37] Medium- and long-term studies (6–12 months) have shown that as patient interest and motivation decrease over time, the effectiveness of smartphone applications in treatment diminishes, leading to deterioration in oral health.[39] Therefore, the present study was designed as a short-term study to mitigate the natural decline in patient interest and motivation.

The results of the present study suggest that maintaining communication with patients through a mobile application yields better outcomes than traditional motivation methods. However, this improvement may be due to the additional attention given to the patients in the study group. Installing an application on patients' phones may have served as a reminder of their involvement in the study and could have helped keep their hygiene motivation active. Therefore, future studies should examine whether the additional attention given to the study group is a causal factor in improving oral hygiene compliance. Additionally, it is not definitively known whether the patients who participated in the study used professional oral care treatments, ozone, laser, or probiotic treatments during the first three sessions, which could potentially have biased the periodontal values. Moreover, since patients' preference for oral hygiene tools other than the standard ones recommended at the beginning of treatment may influence the results so future studies should consider this factor. Previous studies have indicated that these treatments can affect periodontal values.[14] Therefore, further studies on this topic are needed. This study was designed as a short-term intervention to mitigate the natural decline in patient motivation; thus, there is a need for long-term studies that also examine pathological hard tissue loss. Although fixed orthodontic treatments are widely used today, examining the effectiveness of similar applications on hygiene motivation among patients undergoing treatment with clear aligners is also beneficial.

Conclusions

This study demonstrated that direct communication with patients and reminding oral hygiene instructions through e-tel (Ortomobil) increased their motivation to practice oral hygiene and resulted in positive behavioral changes in patients. Therefore, it would be beneficial for orthodontists to take an interest in and actively use such mobile applications as they can help ensure adequate oral hygiene and compliance among patients.

Acknowledgements

No acknowledgements to declare.

Conflicts of Interest statement

No conflicts of interest.

Funding

Granted by Karadeniz Technical University Scientific Research Projects (9623/2021).

References

1. Eppright M, Shroff B, Best AM, et. al. Influence of active reminders on oral hygiene compliance in orthodontic patients. Angle Orthod. 2014;84(2):208-213.
2. Al-Jewair TS, Suri S, Tompson BD. Predictors of adolescent compliance with oral hygiene instructions during two-arch multibracket fixed orthodontic treatment. Angle Orthod. 2011;81(3):525-531.

3. Cantekin K, Celikoglu M, Karadas M, et. al. Effects of orthodontic treatment with fixed appliances on oral health status: a comprehensive study. J Dent Sci. 2011;6(4):235-238.
4. Axelsson P. Current role of pharmaceuticals in prevention of caries and periodontal disease. Int Dent J. 1993;43(5):473-482.
5. Biesbrock AR, Bartizek RD, Walters PA. Improved plaque removal efficacy with a new manual toothbrush. J Contemp Dent Pract. 2008;9(4):1-8.
6. Aljabaa A, McDonald F, Newton JT. A systematic review of randomized controlled trials of interventions to improve adherence among orthodontic patients aged 12 to 18. Angle Orthod. 2015;85(2):305-313.
7. Richter DD, Nanda RS, Sinha PK, et. al. Effect of behavior modification on patient compliance in orthodontics. Angle Orthod. 1998;68(2):123-132.
8. Bartsch A, Witt E, Marks M. The influence of information and communication in the orthodontic consultation and treatment visit. II. The communication style and compliance. J Orofac Orthop. 1995;56(1):7-15.
9. Mehra T, Nanda R, Sinha P. Orthodontists' assessment and management of patient compliance. Angle Orthod. 1998;68(2):115-122.
10. Nanda RS, Kierl MJ. Prediction of cooperation in orthodontic treatment. Am J Orthod Dentofacial Orthop. 1992;102(1):15-21.
11. Sinha PK, Nanda RS. Improving patient compliance inorthodontic practice. Paper presented at: Seminars In Orthodontics2000.
12. Sinha PK, Nanda RS, McNeil DW. Perceived orthodontist behaviors that predict patient satisfaction, orthodontist-patient relationship, and patient adherence in orthodontic treatment. Am J Orthod Dentofacial Orthop. 1996;110(4):370-377.
13. Zachrisson BU. Oral hygiene for orthodontic patients: current concepts and practical advice. Am J Orthod. 1974;66(5):487-497.
14. Tuncer C, Canigur Bavbek N, Balos Tuncer B, et. al. How do patients and parents decide for orthodontic treatment–effects of malocclusion, personal expectations, education and media. J Clin Pediatr Dent. 2015;39(4):392-399.
15. Brattström V, Ingelsson M, Åberg E. Treatment co-operation in orthodontic patients. Br J Orthod. 1991;18(1):37-42.
16. Srai JPK, Petrie A, Ryan FS, et. al. Assessment of the effect of combined multimedia and verbal information vs verbal information alone on anxiety levels before bond-up in adolescent orthodontic patients: a single-center randomized controlled trial. Am J Orthod Dentofacial Orthop. 2013;144(4):505-511.
17. Thomson AM, Cunningham SJ, Hunt NP. A comparison of information retention at an initial orthodontic consultation. Eur J Orthod. 2001;23(2):169-178.
18. Clark GT. Teledentistry: what is it now, and what will it be tomorrow? J Calif Dent Assoc. 2000;28(2):121-126.
19. Jampani N, Nutalapati R, Dontula B, et. al. Applications of teledentistry: A literature review and update. J Int Soc Prev Community Dent. 2011;1(2):37-44.
20. Queyroux A, Saricassapian B, Herzog D, et al. Accuracy of teledentistry for diagnosing dental pathology using direct examination as a gold standard: results of the tel-e-dent study of older adults living in nursing homes. J Am Med Dir Assoc. 2017;18(6):528-532.
21. Özdede M, Bağcı N, Peker İ. COVID-19 pandemisi döneminde tele-diş hekimliği. Türkiye Klinikleri Diş Hekimliği Bilimleri Dergisi. 2020;27(3):482-489.
22. Marino R, Manton D, Hopcraft M, et al. Paediatric teledentistry: delivering oral health services to rural and regional children. 2014.
23. Wike R, Oates R. Emerging nations embrace internet, mobile technology: cell phones nearly ubiquitous in many countries. Washington DC: Pew Research Center. 2014.
24. Fijačko N, Gosak L, Cilar L, et al. The effects of gamification and oral self-care on oral hygiene in children: systematic search in app stores and evaluation of apps. JMIR mHealth and uHealth. 2020;8(7):e16365.
25. Toniazzo MP, Nodari D, Muniz FWMG, et. al. Effect of mHealth in improving oral hygiene: a systematic review with meta-analysis. J Clin Periodontol. 2019;46(3):297-309.
26. Scheerman JF, van Meijel B, van Empelen P, et al. The effect of using a mobile application ("WhiteTeeth") on improving oral hygiene: A randomized controlled trial. Int J Dent Hyg. 2020;18(1):73-83.
27. Greenstein G. The role of bleeding upon probing in the diagnosis of periodontal disease: a literature review. J Periodontol. 1984;55(12):684-688.
28. Löe H, Silness J. Periodontal disease in pregnancy I. Prevalence and severity. Acta Odontol Scand. 1963;21(6):533-551.
29. Silness J, Löe H. Periodontal disease in pregnancy II. Correlation between oral hygiene and periodontal condition. Acta Odontol Scand. 1964;22(1):121-135.
30. Saxena K, Gunjal S. Influence of WhatsApp and electronic mail reminders on oral hygiene compliance of orthodontic patients using planimetry: A randomized clinical trial. J Orofac Orthop. 2022;83(4):269-276.
31. Ozsaygili M. Comparison of different orthodontic aligner systems applied on single stage and three stages in terms of comfort, satisfaction, treatment effects and duration. Kayseri/Turkey 2019.
32. Al-Ak'hali MS, Halboub ES, Asiri YM, et. al. WhatsApp-assisted oral health education and motivation: a preliminary randomized clinical trial. J Contemp Dent Pract. 2020;21(8):922-925.
33. Underwood B, Birdsall J, Kay E. The use of a mobile app to motivate evidence-based oral hygiene behaviour. Br Dent J. 2015;219(4):E2-E2.
34. Abdaljawwad AA. The influence of text message reminders on oral hygiene compliance in orthodontic patients. Iraqi Dent J. 2016;38(1):58-62.
35. Iqbal J, Awan R, Parvez MA, ul Haq A, et. al. Effectiveness of text message instructions on oral hygiene for orthodontic patients. Pak Oral Dent J. 2017;37(2):278-282.
36. Al-Silwadi FM, Gill DS, Petrie A, et. al. Effect of social media in improving knowledge among patients having fixed appliance orthodontic treatment: a single-center randomized controlled trial. Am J Orthod Dentofacial Orthop. 2015;148(2):231-237.
37. Charavet C, Le Gall M, Albert A, et. al. Patient compliance and orthodontic treatment efficacy of Planas functional appliances with TheraMon microsensors. Angle Orthod. 2019;89(1):117-122.
38. Chow J, Cioffi I. Pain and orthodontic patient compliance: a clinical perspective. Paper presented at: Seminars in orthodontics 2018.
39. Deleuse M, Meiffren C, Bruwier A, et. al. Smartphone application-assisted oral hygiene of orthodontic patients: a multicentre randomized controlled trial in adolescents. Eur J Orthod. 2020;42(6):605-611.
40. Papadimitriou A, Kakali L, Pazera P, et. al. Social media and orthodontic treatment from the patient's perspective: a systematic review. Eur J Orthod. 2020;42(3):231-241.
41. Eddhaoui A, Aly TE, Haroon S. Digital Innovation in Oral Health Care: A Comprehensive Review. Open J Stomatol. 2025;15(1):1-24.
42. Hapsari D, Pamungkasari EP, Demartoto A. Effect of Mobile Application Use on Oral Hygiene among Orthodontics Users: Meta-Analysis. J Health Promot Behav. 2024;9(1):38-47.
43. Kim J, Choi Y, Song Y, et. al. Smartphone-Based Telemonitoring for Better Oral Health With Toothbrushes: 6-Month Randomized Controlled Trial. J Med Internet Res. 2025;27:e65128.
44. Lally P, Van Jaarsveld CH, Potts HW, et. al. How are habits formed: Modelling habit formation in the real world. Eur J Soc Psychol. 2010;40(6):998-1009.
45. Gupta G, Vaid N. The world of orthodontic apps. APOS Trends Orthod. 2017;7(2):73-73.