

Effects of perceived vs actual frequency of rewards on orthodontic patient attitudes and compliance

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ABSTRACT

Objectives: To examine the longitudinal association of different reward schedules on patient compliance (as measured by oral hygiene assessments). The cross-sectional associations of actual vs perceived rewards frequency on patient attitudes were also examined.

Materials and Methods: 138 patients undergoing treatment at a university orthodontic clinic were surveyed to collect information on perceived frequency of rewards, likelihood of making patient referrals, and attitudes toward reward programs and orthodontic treatment. Oral hygiene assessment from the most recent appointment and actual frequency of rewards were obtained from patient charts.

Results: Among participants, 44.9% were male, age ranged from 11 to 18 (mean = 14.9 ± 1.7) years; treatment time ranged from 9 to 56 (mean = 23.2 ± 9.8) months. Mean perceived frequency of rewards was 48% while actual frequency of rewards was 19.6%. There were no significant differences in attitudes by actual reward frequency ($P > .10$). However, those who perceived always receiving rewards were significantly more likely to have more positive opinions of reward programs ($P = .004$ and $P = .024$). Age- and treatment-time adjusted analyses showed that always receiving actual rewards was associated with odds of good oral hygiene 3.8 times (95% CI = 1.13, 13.09) higher than those never/rarely receiving actual rewards, but there was no association between perceived rewards and odds of good oral hygiene. Actual and perceived reward frequencies were significantly and positively correlated ($r = 0.40$, $P < .001$).

Conclusions: It is beneficial to give rewards to patients as often as possible to maximize compliance (as shown by hygiene ratings) and foster positive attitudes. (*Angle Orthod.* 2023;93:433–439.)

KEY WORDS: Orthodontic; Compliance; Rewards

INTRODUCTION

Compliance in a health care setting is defined as the extent to which a person's behavior coincides with medical or health advice.¹ In orthodontics, compliance plays a major role in the ultimate success or failure of treatment and can be measured by oral hygiene, appointment punctuality, missed or rescheduled appointments, appliance wear, and appliance maintenance.^{2,3} Noncompliance with oral hygiene may result in early termination of orthodontic treatment,⁴ and missed/rescheduled appointments can delay treatment. Compliance is especially important in orthodontics due to its primarily adolescent patient base but is often more difficult to achieve due to emotional turmoil and changes in parental influence.⁵ The child-parent relationship has been shown to have a strong influence on orthodontic compliance.^{6,7}

There are numerous ways to improve compliance in orthodontic patients. Providing the patient with information and clear communication has been noted to improve compliance.^{1,8} Ross et al. found that daily text

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messages had a greater effect on compliance than weekly text messages.⁹ Another method of increasing compliance is by providing praise or giving small rewards after doing something right (positive reinforcement). This is generally more effective than negative reinforcement or punishment.¹⁰ For an orthodontic practice, rewards in the form of gift cards can be used. For example, with the Patient Rewards Hub program, patients are rewarded with points for compliant behaviors, which can later be exchanged for gift cards.¹¹

However, the few studies that examined the relation between positive reinforcement and compliance yielded conflicting results. For instance, Ardeshtna et al. found no significant differences between compliance before vs after introduction of rewards.¹² Additionally, Richter et al. reported that patients who were rewarded had improved oral hygiene, but did not show significant improvement in other areas of compliance.² However, neither of these studies examined the effects of *frequency* of rewards distribution on patient compliance.

The frequency of reward distribution has been examined in child psychology as well as in health care. Intermittent reinforcement is defined as a reinforced occurrence of a response that has been preceded or succeeded by an unenforced response.¹³ Bijou found that young children rewarded intermittently while playing a game gave more responses during the extinction period than children rewarded continuously.¹³ Lund et al. investigated differing reward schedules on adolescents' use of fluoride rinses and found that, although participation in the rinse program was higher with a continuous rewards schedule, there was less immediate attrition when rewards were withdrawn among those rewarded intermittently.¹⁴ No previous study has examined the effects of partial (or intermittent) reinforcement on orthodontic patient compliance.

The purpose of this study was to examine the relation between perceived and actual frequency of rewards with patient attitudes and compliance, and to determine which had a greater influence on patient compliance, attitudes toward orthodontic treatment and reward programs, and willingness to make referrals.

MATERIALS AND METHODS

Participants

Participants for this study consisted of 138 children who were patients at Roseman University's orthodontic clinic. Patients were eligible for inclusion if they were in full upper and lower fixed appliances (braces), aged 11 to 18 years, and in treatment between July 1, 2020 and April 1, 2021. Excluded were patients older than 18 or younger than 11 years, patients attending emergency appointments, and patients in clear aligners. Institutional Review Board (IRB) approval preceded data

acquisition; written consent from the parent and assent from the child were obtained prior to participation.

Protocol

This study examined the cross-sectional associations of actual vs perceived reward frequency on patient attitudes and the longitudinal association of different reward schedules on patient compliance (as measured by oral hygiene assessments). All variables except actual frequency of rewards and oral hygiene assessments were obtained from paper surveys given to each patient. The surveys were administered from April 1, 2021 to May 21, 2021 during each patient's regular monthly orthodontic appointment. The oral hygiene assessments from these appointments were obtained from patient charts. Actual frequency of rewards was obtained from Patient Rewards Hub (PracticeGenius, San Diego, CA), which provided statistics and included all regular patient visits from July 1, 2020 to May, 2021. Assessment and coding of each outcome variable were:

Oral Hygiene

Information about each patient's oral hygiene assessment was obtained from Dolphin Management software (version 10.5, Dolphin Imaging & Management Solutions, Chatsworth, Calif). Oral hygiene was evaluated as: poor, fair, good, excellent (coded on a scale from 1 to 4). All residents were calibrated using a visual guide from the Crest Ortho Essentials program prior to the start of data collection.¹⁵ The principal investigator reviewed this guide and tested each resident with a five-photo assessment to ensure calibration. The "average" and "not so good" ratings from that guide were consolidated to form the "fair" rating in the Dolphin Management software.

Perceived Frequency of Rewards, Attitudes Toward Reward Programs, Attitudes Toward Orthodontic Treatment, and Likelihood of Referring Others to the Clinic

A survey assessing patient attitudes on a seven-point scale was administered. Patients were asked to indicate on a 1-7 scale (where 1 = not at all and 7 = very much) whether the orthodontic reward program motivated them to come to their appointments on time and keep their braces/teeth clean. Patients were asked to indicate how important orthodontic treatment was for them (with 1 = not important at all and 7 = very important), their overall experience with orthodontics (with 1 = very negative and 7 = very positive), and the likelihood that braces would impact their feelings about themselves (with 1 = no impact at all and 7 = extremely large impact). In addition, the survey asked them to indicate the likelihood they

would refer a friend to the orthodontic clinic (with 1 = not at all likely to 7 = extremely likely).

Perceived frequency of rewards was obtained by asking at what percentage of appointments they thought they received rewards. The survey was administered in paper format and each participant was rewarded 10 points on the Rewards Hub website as an incentive to complete the survey. Actual frequency of rewards (percentage of visits from July 1, 2020 to May, 2021 that they received reward points) was obtained from the Rewards Hub website.

Statistical Analyses

Descriptive statistics including means and standard deviations for all continuous variables (eg, patient age, months into treatment, responses to all survey questions) and rates for all categorical variables (oral hygiene assessment) were calculated. Pearson correlation was used to determine if there was an association between perceived and actual frequency of rewards.

The perceived and actual frequency of rewards were each used separately to divide patients into three groups. The first group contained the patients who received rewards between 0 and one-third of all appointments (rarely/never). The second group contained the patients who received rewards greater than one-third and up to two-thirds of all appointments (intermittent). The third group contained the patients who received rewards at more than two-thirds of all appointments (always). Analysis of variance (ANOVA) for continuous variables and chi-square analysis for categorical variables were used to compare these three groups. Regression analyses were used to examine the associations of actual and perceived frequencies of rewards with each of the attitudes after adjustment for age, gender, and length of time in treatment.

Patients were divided based on oral hygiene assessments into a group with fair to poor oral hygiene and a group with good or excellent oral hygiene. Separate logistic regression analyses examined the associations of perceived and actual frequency of rewards with the oral hygiene assessments, before and after adjustment for age and time in treatment.

Statistical Package for the Social Sciences (SPSS) version 28.0 was used for data analysis. All analyses were two-tailed; $P < .05$ was considered statistically significant.

RESULTS

Overall, 138 patients met the inclusion criteria and consented to participate. As shown in Table 1, 44.9% were male, mean age 14.9 ± 1.7 (range = 11–18) years, and mean time in treatment 23.2 ± 9.8 (range = 9 to 56) months. Mean rating responses for all attitude

Table 1. Demographic, Survey, Oral Hygiene and Reward Characteristics (N = 138)

	Mean	SD
Age (y)	14.9	1.7
Time into treatment (mo)	23.2	9.8
Oral hygiene (as a continuous score)	2.2	0.6
Rewards frequency		
Actual frequency of rewards (%)	19.6	27.4
Perceived frequency of rewards (%)	48.0	40.0
Attitudes		
Prize makes them want to attend appointment ^a	3.9	2.1
Prize incentivizes oral hygiene ^a	4.3	2.2
Importance of having braces ^b	6.3	1.1
Overall experience of braces ^c	5.8	1.1
Likelihood braces will impact feelings about self ^d	6.3	1.0
How likely to refer friend to Roseman Ortho clinic ^e	5.8	1.4
	N	%
Gender		
Male	62	44.9
Female	76	55.1
Perceived rewards frequency (categorical)		
Rarely/never	58	42.0
Intermittent	23	16.7
Always	57	41.3
Actual rewards frequency (categorical)		
Rarely/never	109	79.0
Intermittent	15	10.9
Always	14	10.1
Oral hygiene assessment (categorical)		
Poor	23	16.7
Fair	67	48.6
Good	48	34.8
Excellent	0	0

^a Responses on a 1-7 scale with 1 = not at all and 7 = very much.

^b Responses on a 1-7 scale with 1 = not important at all and 7 = very important.

^c Responses on a 1-7 scale with 1 = very negative and 7 = very positive.

^d Responses on a 1-7 scale with 1 = no impact at all and 7 = extremely large impact.

^e Responses on a 1-7 scale with 1 = not at all likely to refer a friend and 7 = extremely likely to refer a friend.

questions on the survey are also shown in Table 1. Ratings for items assessing importance of having braces, overall experience of braces, likelihood braces would impact feelings about self, and likelihood of referring a friend to the orthodontic clinic were all very high. Mean perceived frequency of rewards, as provided by the survey, was 48% with a bimodal distribution toward always and rarely/never. Mean actual frequency of rewards was 19.6% with over three-fourths (79%) rarely or never receiving rewards. Pearson correlation showed that perceived reward frequency was significantly and positively associated with actual reward frequency ($r = 0.40$ and $P < .001$).

Table 2 shows there were no differences in actual vs perceived frequency of rewards by age or duration of treatment. Females were more likely than males to actually receive rewards (3.2% vs 15.8%), and males were more likely to rarely/never receive rewards

Table 2. Comparison^a of Participant Characteristics by Frequency of Rewards

	Actual Rewards Frequency			χ^2 or F	P
	Rarely/Never	Intermittent	Always		
Age (mean, SD)	14.9 (1.7)	14.5 (1.7)	14.9 (1.2)	0.32	.73
Duration in treatment (mean, SD)	22.9 (10.0)	22.3 (7.6)	26.8 (10.4)	1.05	.35
Gender					
Male (n%)	53 (85.5)	7 (11.3)	2 (3.2)	0.21	.05
Female (n%)	56 (73.7)	8 (10.5)	12 (15.8)		
	Perceived Rewards Frequency			χ^2 or F	P
	Rarely/Never	Intermittent	Always		
Age (mean, SD)	15.1 (1.7)	15.0 (1.5)	14.5 (1.7)	1.73	.18
Duration in treatment (mean, SD)	23.7 (10.8)	24.5 (8.9)	22.2 (9.1)	0.60	.57
Gender					
Male (n%)	26 (41.9)	10 (16.1)	26 (41.9)	0.02	.99
Female (n%)	32 (42.1)	13 (17.1)	31 (40.8)		

^a Comparisons performed with analysis of variance for continuous variables and with chi-square analysis for categorical variables.

(85.5% vs 73.7%). However, there were no significant differences between males and females in perceived reward frequency.

After adjustment for age and length of time in treatment, always receiving actual rewards was significantly associated with 3.8 times (95% confidence interval [CI]: 1.13, 13.09) higher odds of good oral hygiene ($P = .03$) than never/rarely receiving actual rewards (see Table 3). Odds of having good oral hygiene were not significantly higher for those who perceived they always received a reward (OR = 1.08, 95% CI: 0.49, 2.37) (Table 3).

Figures 1 and 2 show comparisons of mean survey ratings by actual and perceived frequency of rewards. There were no significant differences in any of the ratings by actual reward frequency ($P > .10$; see Figure 1). However, those who perceived they always received rewards were significantly more likely to indicate that knowing they would get a prize made them want to come to their braces appointment ($P = .004$), and more likely to indicate that knowing they would get a prize motivated them to practice good oral hygiene ($P = .024$). Similar results were obtained in

regression analyses adjusted for age and months into treatment examining the association of perceived rewards with wanting to come to their braces appointment ($r = 0.25$, $P = .002$) and being motivated to practice good oral hygiene ($r = .19$, $P = .02$).

DISCUSSION

This study found that, although significantly correlated, perceived frequency of rewards had a greater effect on patient attitudes (toward reward programs), while actual frequency of rewards had a greater effect on compliance. Patients who always received *actual* rewards had the best compliance as shown by better oral hygiene, whereas patients who *perceived* they always received rewards had the most positive attitudes. In addition, perceived frequency of rewards was significantly and positively associated with actual reward frequency. This was the first study to examine the effects of *frequency* of reward distribution on patient compliance and attitude. In this study, participants who received partial reinforcement had the lowest compliance (as shown by lower odds of good oral hygiene), and least positive attitudes compared to

Table 3. Unadjusted and Adjusted^a Associations of Frequency of Rewards With Oral Hygiene^b (OH) Assessment

Frequency of Rewards	Good Oral Hygiene (OH)			
	Unadjusted Odds Ratio		Adjusted Odds Ratio	
	OR (95% CI)	P Value	AOR ^a (95% CI)	P Value
Actual rewards frequency				
Rarely/never (reference)				
Intermittent	0.74 (0.22–2.48)	.62	0.74 (0.22–2.56)	.64
Always	2.70 (0.87–8.38)	.09	3.85 (1.13–13.09)	.03
Perceived rewards frequency				
Rarely/never (reference)				
Intermittent	0.49 (0.16–1.51)	.21	0.50 (0.16–1.59)	.24
Always	1.11 (0.52–2.36)	.79	1.08 (0.49–2.37)	.85

^a Adjusted by age and months into treatment; results of logistic regression analysis.

^b OH assessment was on a categorical scale with excellent/good vs fair/poor.

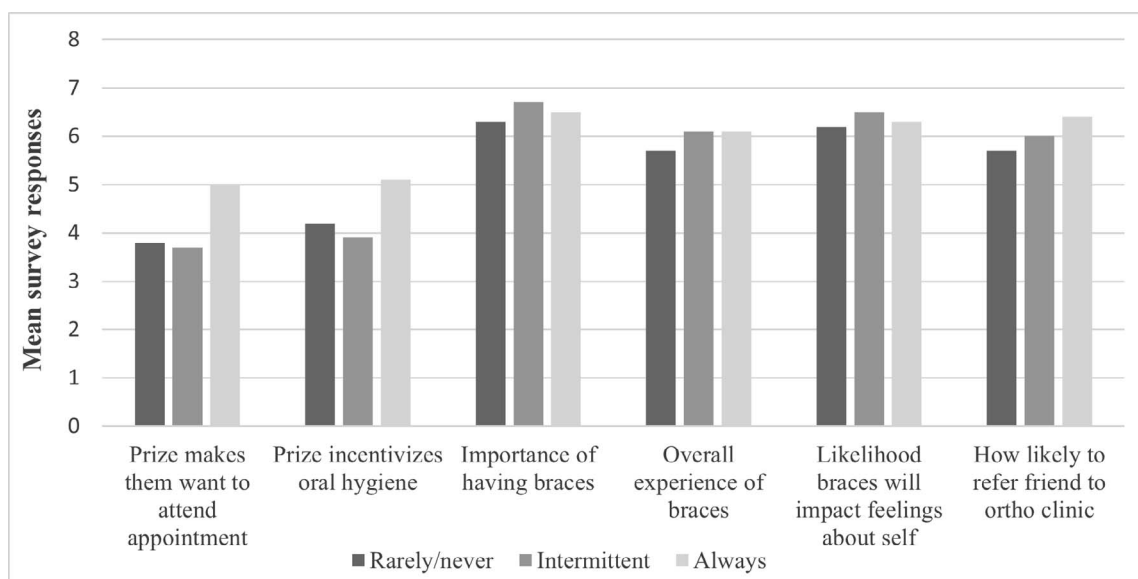


Figure 1. Comparison of mean attitude ratings on the survey by actual reward frequency.^a Responses on a 1-7 scale with 1 = not at all and 7 = very much.^b Responses on a 1-7 scale with 1 = not important at all and 7 = very important.^c Responses on a 1-7 scale with 1 = very negative and 7 = very positive.^d Responses on a 1-7 scale with 1 = no impact at all and 7 = extremely large impact.^e Responses on a 1-7 scale with 1 = not at all likely to refer a friend and 7 = extremely likely to refer a friend.

participants who always or never/rarely received rewards. This was likely the first study to examine the effects of partial (or intermittent) reinforcement on orthodontic patient compliance.

After adjustment for age and length of time in treatment, always receiving actual rewards was significantly associated with odds of good oral hygiene that were 3.8 times higher than those who never/rarely

received actual rewards. Although the relatively wide confidence interval suggested some instability of this estimate, it nevertheless indicated that it would be beneficial to give rewards to patients at every appointment to maximize their compliance.

The results of this study were in agreement with Lund et al.,¹⁴ who, in a sample of 363 boys and 369 girls in seventh grade, reported that continuous

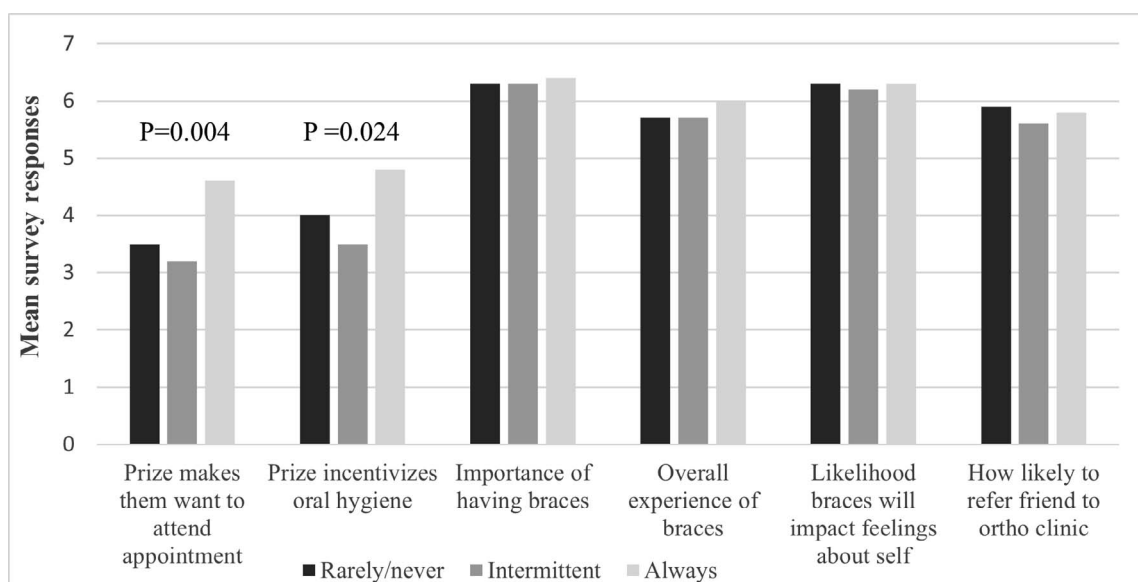


Figure 2. Comparison of mean attitude ratings on the survey by perceived reward frequency.^a Responses on a 1-7 scale with 1 = not at all and 7 = very much.^b Responses on a 1-7 scale with 1 = not important at all and 7 = very important.^c Responses on a 1-7 scale with 1 = very negative and 7 = very positive.^d Responses on a 1-7 scale with 1 = no impact at all and 7 = extremely large impact.^e Responses on a 1-7 scale with 1 = not at all likely to refer a friend and 7 = extremely likely to refer a friend.

reinforcement resulted in the greatest compliance and that intermittent reinforcement resulted in lower compliance. That study also found that continuous reinforcement resulted in more positive attitudes about the reward program. Results of the present study were also in agreement with a review that concluded that response strength was strongest and maintained better with continuous reinforcement than with partial reinforcement schedules.¹⁶ However, results obtained in this study were in contrast to Ardeshtna et al., who, in a sample of 16 boys and 19 girls aged 11 to 17 years, found that rewards did not significantly affect orthodontic patient compliance.¹²

Although the mean perceived frequency of rewards was 48.0%, the mean actual frequency of rewards was only 19.6%, suggesting the rewards program was not fully used by residents, and that participants were not being adequately incentivized. Given that perceived reward frequency and actual reward frequency were positively and significantly correlated, increases in actual reward frequency should lead to more positive attitudes toward reward programs.

There were significant differences in attitudes toward reward programs by perceived reward frequency, but there were no significant differences in responses to questions regarding the importance of having braces, overall experience of having braces, impact on feelings about self and likelihood of referring friends. This could be explained by the greater variability in responses concerning attitudes toward the rewards, which had means of 3.9 ± 2.1 and 4.3 ± 2.2 , whereas the responses to the remaining questions on the importance, experience and impact of braces, and likelihood of referral were all uniformly high with means ranging from 5.8 to 6.3 and standard deviations of only 1.0–1.4.

This study found that neither perceived nor actual frequency of rewards had significant impact on patients' overall feelings about braces and likelihood to refer friends to the orthodontic clinic. Responses to both these questions were very positive; therefore, lack of significant differences may have been due to the low variability of responses or a ceiling effect among these items. Other factors and experiences may also have been more important than rewards. For instance, patient perceptions of their own malocclusion can have a significant impact on their overall feeling about braces.¹⁷ No studies have investigated the factors that influence likelihood of making referrals, and further research on this topic is needed.

Females in the study were more likely to actually receive rewards than males (15.8% vs 3.2%, respectively), which could have introduced some confounding. However, this could be explained by girls showing more compliant behavior than boys,^{18,19} or reflect gender differences in rates of good oral hygiene.^{20,21}

A recent literature review concluded that men had poorer oral hygiene than women.²⁰ Additionally, a study of 440 males and 398 female teenagers found that females had higher levels of oral health behavior than males.²¹

Results of this study are plausible. According to learning theory, learning a response occurs quickly with continuous reinforcement but is easily forgotten when reinforcement is withdrawn.²² In this study, compliance was highest with continuous reinforcement, but whether compliance would continue to be high after the withdrawal of rewards was not investigated. Others, such as Lund et al.¹⁴ reported that continuous reinforcement resulted in the greatest compliance and that intermittent reinforcement resulted in lower compliance. No previous study investigated the differences between intermittent reinforcement vs rare/no reinforcement.

Several limitations were considered. Only one measure of compliance (oral hygiene assessment) was obtained. Although oral hygiene assessment was a calibrated proxy for compliance in this study, numerous confounders, including whether a manual or automatic toothbrush was used, manual dexterity of the patient, and toothbrushing technique, could affect oral hygiene, but were not assessed in this study. Because this study was limited to a single orthodontic clinic in one location, results may not be generalizable to other orthodontic clinics in other locations. There was also no extra appointment time allotted for survey completion and, thus, participants might have felt rushed to complete the survey, possibly affecting the validity of some responses.

This study also had many strengths. The effects of frequency of rewards (actual or perceived) on orthodontic compliance had not been investigated previously. The results also had practical implications for orthodontic offices thinking of implementing rewards programs. In addition, the longitudinal study design assured that actual/perceived rewards preceded oral hygiene assessment. Finally, a relatively large sample size ($N = 138$) was used.

CONCLUSIONS

- Actual frequency of rewards has a greater effect on patient compliance as assessed by oral hygiene, but perceived frequency of rewards has a greater effect on patient attitudes toward reward programs.
- Rewards given on an intermittent schedule result in lower compliance and less positive attitudes than rewards given all the time and rewards given rarely/never.
- It is beneficial to give reward points to patients at every appointment to maximize patient compliance.

- Reward programs do not have a significant impact on patients' overall feelings about orthodontic treatment and likelihood of making referrals.
- Future studies should have larger sample sizes to enable stratification by age and time in treatment, and should also assess other forms of orthodontic patient compliance such as appointment punctuality, broken brackets, and appliance wear/maintenance.

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