

A systematic review of randomized controlled trials of interventions to improve adherence among orthodontic patients aged 12 to 18

AlJazi Aljabaa^a; Fraser McDonald^b; Jonathon Timothy Newton^c

ABSTRACT

Objective: To investigate the effectiveness of interventions to enhance adherence among orthodontic patients aged 12 to 18 years. Specific adherence outcomes included were recall of information given by the orthodontic team, attendance at orthodontic appointments, self-reported oral hygiene behavior, and clinical indexes of oral hygiene.

Materials and Methods: Electronic searches of Medline via OVID (January 1, 1966 through March 1, 2012), EMBASE, and the Cochrane central register of control trials from its inception through March 2012, as well as a hand search, were undertaken to identify relevant studies.

Results: Through the electronic searches, 381 article were identified. Initial screening of the abstracts and titles by all review authors identified 21 articles that met the inclusion criteria for this review. The full articles were then retrieved. Four randomized controlled trials were found, all of which used different methods of intervention: a system of rewards or awards, the Hawthorne effect, written information, and demonstration of the microbiology of plaque. All the interventions, except the use of award/reward, were associated with improvements in adherence.

Conclusion: The literature advocates the use of several methods to improve compliance/adherence among orthodontic patients. Although there is insufficient evidence to allow clinicians to choose a single method, the results demonstrate the value of spending time with patients to illustrate the importance of adherence. Future studies should develop multiple methods of assessing patient adherence, including self-report, behavioral observation and recording, and change in clinical indexes. Such studies should test different types of interventions for effectiveness. (*Angle Orthod.* 2015;85:305–313.)

KEY WORDS: Adherence; Compliance; Systematic review; Orthodontics; Randomized controlled trial

INTRODUCTION

Compliance, as it relates to health care, is the extent to which a person's behavior coincides with medical or health advice.¹ A physician-led approach to prescribing

treatment came to be described as "compliance" in the medical literature of the 1950s. This word quickly became unpopular for its judgmental overtones, and alternatives were sought. "Adherence" was then introduced and used interchangeably with compliance.²

Adherence is defined as the extent to which a person's behavior, such as taking medication, following a diet, and/or executing lifestyle changes, corresponds with recommendations the person has agreed to with a healthcare provider.³ It also implies that people freely choose to undertake behavioral plans, have input to them, and have collaborative involvement in developing and adjusting their treatment strategy.⁴ One of the most difficult challenges that face a dental team is supporting patients in changing and sustaining change in their oral health behaviors.³ In orthodontics, adherence relates to keeping appointments, maintaining good oral hygiene, wearing elastics, wearing functional appliances or headgear as

^a PhD student, Department of Orthodontics, Dental Institute, King's College London, London, UK.

^b Professor of Orthodontics, Department of Orthodontics, Dental Institute, King's College London, London, UK.

^c Professor of Psychology as Applied to Dentistry, Department of Oral Health Services Research & Dental Public Health, Dental Institute, King's College London, London, UK.

Corresponding author: Dr AlJazi Aljabaa, Department of Orthodontics, Dental Institute, King's College London, Great Maze Pond, London SE19RT, UK
(e-mail: aljazi.aljabaa@kcl.ac.uk)

Accepted: May 2014. Submitted: March 2014.

Published Online: July 21, 2014

© 2015 by The EH Angle Education and Research Foundation, Inc.

instructed, and avoiding foods that can debond the brackets.

Interventions aimed at enhancing health-related behaviors typically target three aspects of the behavior: capability, opportunity, and motivation.⁵ Capability (C) refers to the physical and psychological skills to perform the behavior (B). Opportunity (O) has physical components (eg, access to resources) and social environment aspects (eg, exposure to ideas) such that the person feels able to undertake the new behavior. Finally, motivation (M) refers to the person's conscious (eg, planning and decision making) and automatic (eg, innate drives, emotional reactions, habits) processes said to underline any behavior. Michie and West⁶ describe a "behavior change wheel" to demonstrate how existing behavioral change interventions map to this COM-B model.

Traditionally, many interventions in the dental field have focused on providing patients with improved knowledge of their disease. Patients who have a good knowledge of their disease or procedures have a better outcome than those who do not.⁷ Furthermore, Ley⁸ stated that providing the patient with greater information generally leads to increased compliance with treatment recommendations. Good communication is also associated with improved clinical outcome.⁹ In order for a communication to be effective, it must be both remembered and understood.¹⁰ Patients often do not understand or misinterpret the information given to them. Frequently, this is because the information is given in an inappropriate form. Material written by clinicians may be too technical or difficult for the patients to understand or ambiguous.⁸ In the same context, Thickett and Newton¹¹ assessed how three different methods of presenting information affected recall of information in orthodontic patients in the short and long term. They found that mind mapping and acronyms convey a significant advantage in patient recall of information.

The aim of this article is to investigate the effectiveness of interventions to enhance adherence among orthodontic patients aged 12 to 18 years. Specific adherence outcomes included were recall of information given by the orthodontic team, attendance at orthodontic appointments, self-reported oral hygiene behavior, and clinical indexes of oral hygiene.

MATERIALS AND METHODS

A systematic review of interventions aimed at improving adherence to advice given to orthodontic patients aged 12 to 18 years regarding key behaviors (appointment attendance, oral hygiene-related behaviors) was conducted.

Inclusion Criteria

The following inclusion criteria were used:

- Type of studies: Randomized controlled studies with a before and after design were included.
- Participants: Participants were 12- to 18-year-olds undergoing upper and lower fixed orthodontic appliances treatment.
- Types of interventions: These included verbal advice, written advice, interventions based on psychological theories, and educational interventions.
- Comparisons: These included intervention vs no intervention or comparisons of two or more interventions.

Outcomes

The following primary outcomes were examined:

- Recall of information as measured by a validated questionnaire.
- Attendance at orthodontic appointments as recorded in the dental and medical notes.
- Self-reported behavior.
- Clinical indexes, such as the Plaque Index.

The following secondary outcomes were examined:

- Motivation for orthodontic treatment, as assessed by any validated questionnaire.
- Expectation of orthodontic treatment, as assessed by any validated questionnaire.
- Apprehension and worries about orthodontic treatment, as assessed by any validated questionnaire.

Information Sources

All studies were identified through electronic and hand searches. All relevant studies were identified without regard for language, that is, non-English articles were considered for inclusion after an accurate translation.

An electronic search was conducted using Medline via OVID (January 1, 1966 through March 1, 2012), EMBASE, and the Cochrane central register of control trials until March 2012. The search strategy is listed in Table 1.

A hand search was also undertaken to identify relevant studies from the following journals: *American Journal of Orthodontics and Dentofacial Orthopedics*, *The Angle Orthodontist*, *European Journal of Orthodontics*, and *The Journal of Orthodontics*.

Authors of the included studies were contacted by the review authors, when needed, to obtain any further information about additional or unpublished studies that were eligible for inclusion in the review.

Table 1. Search Methodology for Electronic Systematic Review

Section	No. of Studies
Section A: adherence	
1. Adherence .exp	69,846
2. Compliance .exp	102,181
3. Concordance .mp	21,510
4. 1 OR 2 OR 3	179,151
Section B: orthodontics	
1. "Orthodontics".exp	21,664
Combine A and B	
1. 4 and 5	390
Limit to human	381

Study Selection and Data Extraction

The titles and abstracts resulting from the searches were independently screened by two of the review

authors to select potentially relevant studies (AA, JTN). The full text of each study was obtained, and inclusion was assessed independently and in duplicate. Any disagreement regarding the inclusion or exclusion of a study was resolved by discussion or referred to a third reviewer. The full data extraction and quality assessment were conducted by three reviewers using a specifically designed data extraction form. The variables for which data were sought are summarized in Table 2.

Risk of Bias Analysis

Each of the randomized controlled trials found in the search was reviewed using the CONSolidated Standards Of Reporting Trials (CONSORT, <http://www.consort-statement.org/consort-2010>, Accessed July 4 2014) criteria for risk of bias. Given that the reviews

Table 2. Summary of Data Extraction

Author	Year	Nature of Intervention	Sample Size	Age	Orthodontic Status	Gender	Outcomes Measures
Acharya et al. (N = 62)	2011	Group 1: conventional plaque control	21	12–18 years	Fixed appliances No further information	No information	Plaque score Immediate 1 month 3 months 6 months
		Group 2: chair-side motivational tests with conventional plaque control	23				
		Group 3: microscope demonstration of plaque	18				
Wright et al. (N = 60)	2010	Intervention group: fixed appliances and leaflet about fixed appliances	29	12–16 years	Upper and lower fixed ortho	No information	Motivation Apprehension Anxiety Appointment attendance Periodontal status Appliance breakages T1: the beginning of treatment T2: 4 weeks T3: 12 weeks
		Control group: Verbal information about fixed appliances	31				
Feil et al. (N = 40)	2002	Intervention group: oral hygiene instructions and the Hawthone effect	20	14–18 years	Fixed orthodontic appliance	10 boys, 10 girls	Plaque score: immediate, 3 months, 6 months
		Control group: no intervention	20				
Richter et al. (N = 144)	1998	Control group: received standard instructions Award group: received compliance instructions and a written evaluation of compliance Reward group: received compliance instructions, a report card, and eligibility to receive rewards for adherent behavior.	144	9.6–17.6 years	No information	No information	Orthodontic Patient Compliance Scale to compare compliance before and after the 6-month experimental period Clinical evaluation of compliance that was based on oral hygiene, appointment punctuality, appliance wear, and appliance maintenance.

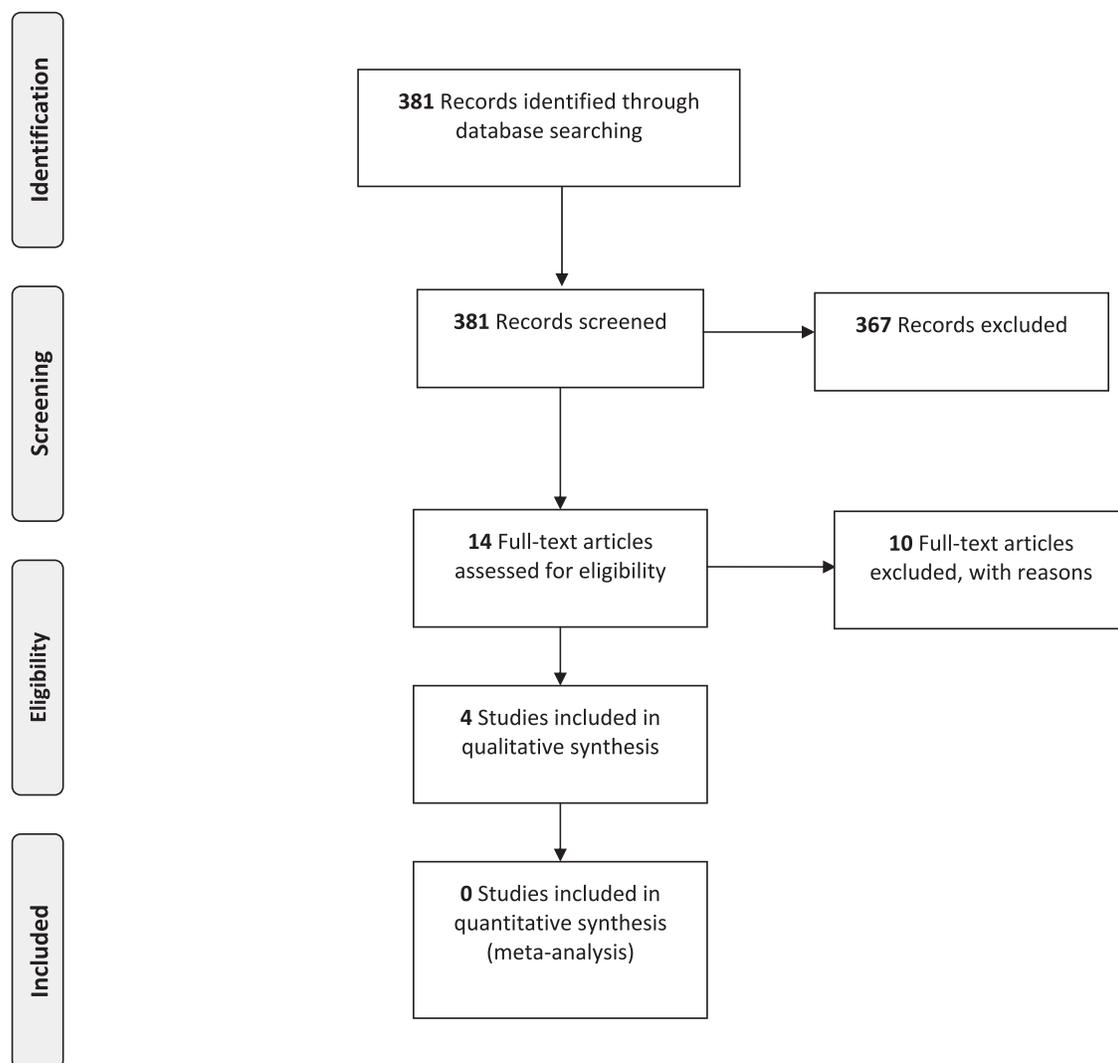


Figure 1. Flow chart demonstrating number of records identified and removed at each stage of the review.

were based on published studies; there is a risk of publication bias in the findings.

Data Analysis

A meta-analysis was planned combining data across studies to test the efficacy of interventions, provided that the data were sufficiently homogeneous and there was sufficient homogeneity in the types of intervention reported.

RESULTS

Through the electronic searches, 381 articles were identified. Of these, 376 proved to not be of direct relevance to the two systematic reviews we were conducting, typically because they were addressing a different orthodontic topic (though they mentioned the importance of compliance in orthodontic treatment) or

were not trials. Four randomized controlled trials were included (See Figure 1).

Meta-analysis was not performed because of methodologic heterogeneity among the selected trials. The outcome measures chosen were different for each article. Each study will be viewed and appraised separately. Table 3 display the characteristics of the included randomized clinical trials.

In the first randomized controlled trial identified Richter et al.¹² evaluated the effect of a reward system on improving compliance among orthodontic patients. Participants were 144 patients (63 boys, 81 girls) with an age range of 9.6 to 17.6 years who underwent orthodontic treatment. The patients were divided into three groups: a control group who received standard instructions; an award group who received compliance instruction and completed a written evaluation of compliance; and a reward group who received compliance

Table 3. Characteristics of the Included Randomized Clinical Trials

Author	Sample Size	Age	Intervention	Outcome	Baseline T1	Follow-up T2	Follow-up T3						
Richter et al. (1998)	N = 144	(9.6–17.6 years)	1: Control	1: Oral hygiene	Mean ± SD	6 Months	No T3						
			2: Award for compliance	High control High award High reward	19.6 ± 5.6 16.6 ± 4.3 19.2 ± 6.8	18.3 ± 6.7 15.6 ± 8.1 17.7 ± 5.4							
			3: Reward for compliance	Low control Low award Low reward	14.4 ± 7.1 14.1 ± 4.7 16.2 ± 5.9	11.6 ± 7.9 14.5 ± 6.6 17.4 ± 4.8							
			(All participants were divided into high and low compliers before assigning them to a specific group)	2: Appointment attendance	High control High award High reward Low Control Low award Low reward	25.0 ± 8.3 21.4 ± 8.1 24.3 ± 2.4 22.5 ± 6.2 20.0 ± 9.8 24.5 ± 2.2	25.6 ± 6.7 20.5 ± 7.5 24.5 ± 2.2 23.7 ± 3.1 22.9 ± 5.8 23.7 ± 5.6						
				3: Appliance wear	High control High award High reward Low control Low award Low reward	25.4 ± 22.4 19.1 ± 5.2 19.6 ± 4.9 10.5 ± 9.1 10.7 ± 10.2 13.6 ± 8.1	23.1 ± 10.4 18.9 ± 6.5 16.9 ± 9.6 9.9 ± 7.6 15.7 ± 6.9 18.6 ± 3.5						
				4: Appliance maintenance	High control High award High reward Low control Low award Low reward	26.8 ± 7.8 22.9 ± 6.3 22.9 ± 6.8 24.4 ± 2.4 23.7 ± 5.2 22.5 ± 5.5	25.7 ± 9.2 20.8 ± 5.5 20.5 ± 2.2 21.7 ± 7.6 20.8 ± 9.6 24.5 ± 2.3						
			Feil et al.* (2002)	N = 38	(14–18 years)	1: Control	Plaque Index	Mean ± SD	3 Months	6 Months			
						2: Hawthorne effect	Control Hawthorne	74 ± 11.46 71 ± 11.52	78 ± 12.18 54 ± 13.79	79 ± 10.76 52 ± 13.04			
			Wright et al. (2010)	N = 60	(12–16 years)	1: Control (verbal information only)	1: Anxiety	Mean	4 Weeks	12 Weeks			
						2: Intervention (verbal and written information)	Control Intervention	30.37 30.64	28.73 32.40	28.31 32.84			
							2: Motivation	Control Intervention	32.44 28.43	34.79 25.91	29.82 31.22		
							3: Apprehension	Control Intervention	31.32 29.62	29.15 31.95	29.24 31.84		
							4: Periodontal examination	Control Intervention	30.79 30.19	30.89 30.09	26.50 34.78		
						Acharya et al. (2011)	N = 62	(12–18 years)	1: Conventional plaque control	Plaque Score	Mean ± SD	3 Months	6 Months
									2: Chair-side motivational tests with conventional plaque control	Group 1 Group 2	1.1071 ± 0.3327 1.1250 ± 0.3352	1.0139 ± 0.3755 0.9457 ± 0.3525	1.0720 ± 0.0647 1.0455 ± 0.3915
									3: Microscope demonstration	Group 3	1.1343 ± 0.4211	0.9514 ± 0.2786	0.6410 ± 0.3984

* Feil et al. (2002) study, two individuals dropped out at the 6 months follow up. In the manuscript, data was reported only for participants with complete data at all points, lowering the sample size from 40 to 38.

Table 4. Risk of Bias for the Four Randomized Controlled Trials as Judged by CONSORT* Criteria

CONSORT Checklist	Richter et al.	Feil et al.	Wright et al.	Acharya et al.
Title and abstract				
a. Identification as a randomized trial in the title	No	Yes	Yes	Yes
b. Structured summary of trial design, methods, results, and conclusions (for specific guidance see CONSORT for abstracts)	Yes	Yes	Yes	Yes
Introduction				
Background and objectives				
a. Scientific background and explanation of rationale	Yes	Yes	Yes	Yes
b. Specific objectives or hypotheses	Yes	Yes	Yes	Yes
Methods				
<i>Trial design</i>				
a. Description of trial design (eg, parallel, factorial), including allocation ratio	No	No	Yes	Yes
b. Important changes to methods after trial commencement (eg, eligibility criteria) with reasons	No	No	No	No
Participants				
a. Eligibility criteria for participants	Yes	Yes	Yes	Yes
b. Settings and locations where the data were collected	Yes	Yes	Yes	Yes
Interventions				
The interventions for each group with sufficient detail to allow replication, including how and when the interventions were actually administered	Yes	Yes	Yes	Yes
Outcomes				
a. Completely defined prespecified primary and secondary outcome measures, including how and when they were assessed	Yes	Yes	Yes	Yes
b. Any changes to trial outcomes after the trial commenced with reasons	No	No	No	No
Sample size				
a. How the sample size was determined	No	No	No	No
b. When applicable, explanation of any interim analyses and stopping guidelines	No	No	No	No
Randomization:				
Sequence				
a. Method used to generate the random allocation sequence	No	Yes	Yes	Yes
generation				
b. Type of randomization; details of any restriction (eg, blocking and block size	No	Yes	Yes	Yes
Allocation				
Concealment mechanism				
Mechanism used to implement the random allocation sequence (eg, sequentially numbered containers), describing any steps taken to conceal the sequence until interventions were assigned	No	Yes	No	Yes
Implementation				
Who generated the random allocation sequence, who enrolled participants, and who assigned participants to interventions	No	Yes	No	Yes
Blinding				
a. If done, who was blinded after assignment to interventions (eg, participants, care providers, those assessing outcomes) and how	Yes	Yes	No	No
b. If relevant, description of the similarity of interventions	Yes	No	No	Yes
Statistical methods				
a. Statistical methods used to compare groups for primary and secondary outcomes	Yes	Yes	Yes	Yes
b. Methods for additional analyses (eg, subgroup analyses and adjusted analyses)	No	Yes	Yes	Yes
Results				
Participant flow (a diagram is strongly recommended)				
a. For each group, the numbers of participants who were randomly assigned, received intended treatment, and were analyzed for the primary outcome	Yes	Yes	Yes	Yes
b. For each group, losses and exclusions after randomization, together with reasons	No	Yes	No	No

Table 4. Continued

CONSORT Checklist	Richter et al.	Feil et al.	Wright et al.	Acharya et al.
Recruitment				
a. Dates defining the periods of recruitment and follow-up	Yes	Yes	Yes	Yes
b. Why the trial ended or was stopped	No	Yes	No	No
Baseline data				
a. Table showing baseline demographic and clinical characteristics for each group	Yes	Yes	Yes	Yes
Numbers analyzed				
For each group, number of participants (denominator) included in each analysis and whether the analysis was by original assigned groups	Yes	Yes	Yes	Yes
Outcomes and estimation				
a. For each primary and secondary outcome, results for each group, and the estimated effect size and its precision (such as 95% confidence interval)	Yes	Yes	Yes	No
b. For binary outcomes, presentation of both absolute and relative effect sizes is recommended	No	No	No	No
Ancillary analyses				
Results of any other analyses performed, including subgroup analyses and adjusted analyses, distinguishing prespecified from exploratory	Yes	Yes	Yes	No
Harms				
All important harms or unintended effects in each group (for specific guidance see CONSORT for harms)	No	No	No	No
Discussion				
Limitations				
Trial limitations, addressing sources of potential bias, imprecision, and, if relevant, multiplicity of analyses	Yes	Yes	No	No
Generalizability				
Generalizability (external validity, applicability) of the trial finding	No	Yes	Yes	Yes
Interpretation				
Interpretation consistent with results, balancing benefits and harms, and considering other relevant evidence	Yes	Yes	Yes	Yes
Other information				
Registration				
Registration number and name of trial registry	No	No	No	No
Protocol				
Where the full trial protocol can be accessed, if available	Yes	Yes	Yes	Yes
Funding				
Sources of funding and other support (eg, supply of drugs), role of funders	No	Yes	No	No

* CONSORT is defined as CONSolidated Standards of Reporting Trials.

instructions, a report card, and eligibility to receive rewards for adherent behavior. The patients in each group were divided into two main categories—high compliers and low compliers—using the Orthodontic Patient Cooperation Scale, which is used to evaluate patients' compliance at the initiation of investigation and after 6 months of treatment. Outcomes assessed were oral hygiene, appointment attendance, appliance wear, and appliance maintenance. The researchers compared compliance before and after 6 months of treatment. The results showed that there was no significant improvement for above-average compliers

who received rewards. Below-average compliers did not improve significantly either. However, the oral hygiene scores for the low compliers in the reward group were better than scores for the low compliers in the control group.

Feil et al.¹³ used a single-blind, quasi-random assignment of 40 patients ranging in age from 14 to 18 years old with poor oral hygiene and who were undergoing fixed orthodontic treatment. The patients were randomly assigned to two groups of 20 patients. In the intervention group, the Hawthorne effect¹⁴ was induced by approaching the subjects during a regular

appointment and telling them that they were participating in an experiment evaluating the effectiveness of a new orthodontic toothpaste (in reality, regular Crest with fluoride, Procter & Gamble) that would improve the oral health of orthodontic patients specifically. All toothpaste was provided in an unmarked tube except for patient identifier number. The 20 patients in the control group were not asked to participate in any activity not usually practiced during their orthodontic treatment. The outcome measured was the plaque index. Results showed that there was no plaque score difference between groups at baseline ($P > .05$). Means and standard deviations for tooth surface covered with disclosed plaque for the study and control groups, respectively, were 71% (± 11.52) and 74% (± 11.46) at baseline; 54% (± 13.79) and 78% (± 12.18) at 3 months; and 52% (± 13.04) and 79% (± 10.76) at 6 months. Finally, the intervention group showed better reduction in plaque scores at 3 and 6 months.

Wright et al.¹⁵ measured the influence of supplemental written information on adolescent anxiety, motivation, and compliance on 60 patients (age range 12–16 years) who did not undergo previous orthodontic treatment and required dual-arch appliance therapy. Randomization was done using computer-generated unstratified allocation sequence in two groups. The intervention group received verbal and written information while the control group received verbal instructions only. Outcomes measured were motivation, apprehension, anxiety, and compliance (ie, appointment attendance, periodontal status, and appliances breakages) at the beginning of treatment (T1), after 4 weeks of treatment (T2), and at 12 weeks of treatment (T3). Results showed that there was no median change in anxiety scores for either group between T1 and T2. There was a statistically significant difference in motivation scores between the groups after consent to orthodontic treatment, that is, the intervention group became more motivated. Although a generalized reduction in anxiety, motivation, and apprehension as treatment progressed was demonstrated by the negative differences between T1 and T3 for both groups, these differences were not significant. The intervention group's periodontal condition improved between T1 and T3, in contrast to the control group's periodontal condition. At T3 both groups showed similar levels of motivation, apprehension, and anxiety but the intervention group was better in appointment attendance, periodontal status, and appliance breakage.

Acharya et al.¹⁶ randomly allocated 62 orthodontic patients (age range 12–18 years) to three types of intervention. Randomization was performed using a systematic random sampling technique. Group 1 consisted of 21 patients who were motivated through

conventional plaque-control measures (ie, plaque was disclosed with 2% mercurochrome). The composition of plaque, its effects on oral health, and the importance of its removal were stressed, and a horizontal scrubbing technique of brushing was demonstrated to the patients. Group 2 consisted of 23 patients who were motivated for dental plaque removal using chair-side motivational techniques. As in group 1, conventional plaque control measures were also demonstrated to the patients. Group 3 consisted of 18 patients who were motivated by showing them live motile bacteria in their own plaque under a phase contrast microscope. This study measured the plaque and gingival indexes at baseline, 1 month, 3 months, and 6 months. Results showed that plaque scores for group 3 were better than those for groups 1 and 2 at 3 months and 6 months.

Table 4 summarizes the risk of bias for the four randomized controlled trials as judged by the CONSORT criteria.

DISCUSSION

A number of interventions are advocated in the literature to improve patients' adherence during orthodontic treatment. Richter et al.¹² used the report card and reward system in an attempt to improve adherence among 144 orthodontic patients. The results indicated that only oral hygiene improvement was found among the low compliance reward group compared with the low compliance award group. The finding of this study did not support the hypothesis that the award/reward intervention might improve compliance. A possible reason is the lack of attractiveness in the rewards that were used in the study, which might have influenced the results. The study mentioned that the patients were divided into high and low compliers using the Orthodontic Patient Cooperation Scale but did not indicate if calibration was considered by interexaminer reliability measurement. Furthermore, the study included patients with banding/bonding of the entire arch and some patients who were using headgear and other appliances. Appliance wear was measured on a nine-point scale by nine supervising faculty members; however, interexaminer reliability was not considered. Although the results indicated gender differences among the groups, a detailed description of the actual male/female participants in each group was not clearly provided.

In another study, the Hawthorne effect was evaluated in improving patients' compliance.¹³ The strength of the study lies in the randomization of two equal groups as well as the explicit and concise selection criteria. In the experimental group, the patients were asked to return the experimental toothpaste at the end of the study, which would indicate whether they

complied with the instructions. The outcome revealed a reduction in plaque score in the experimental group. The Hawthorne effect might be an asset in improving compliance in orthodontic patients.¹³ However, compliance in this study was measured by oral hygiene improvement using the Plaque Score Index only. The study did not investigate whether the Hawthorne effect influences compliance in terms of appointment attendance and appliance wear.

Wright et al.¹⁵ studied how written and verbal information affected anxiety, motivation, and compliance among 76 orthodontic patients. Results showed improvement in appointment attendance, appliance breakage, and periodontal condition in the intervention group, but this improvement was not statistically significant. The sample size was relatively small; a larger sample might have provided more convincing evidence. This study highlighted the importance of information retention in orthodontic treatment as they found that the initial positive effect of written information was not maintained throughout the treatment.

In the fourth study, the effect of three interventions to improve oral hygiene among 78 patients undergoing fixed orthodontic treatment was investigated.¹⁶ The researchers found that plaque and gingival scores reduced in group 3 patients, who were motivated by being shown live motile bacteria in their own plaque under a phase contrast microscope. One drawback to the study was the lack of a clear description on how the plaque and gingival scores were measured. Also, no information was provided on the number of examiners undertaking the assessment of plaque and gingival scores. Lastly, interexaminer and intraexaminer reliability were not reported.

The quality of the randomized controlled trials located for this review was moderate. Particular concerns related to determination of an appropriate sample size as none of the four trials identified the basis on which the sample size was determined. There were also issues concerning allocation concealment and blinding for the studies.

CONCLUSIONS

- The literature advocates the use of several methods to improve compliance/adherence among orthodontic patients. Although there is no evidence to support one particular intervention over another, the results demonstrate the value of spending time with patients to illustrate the importance of adherence.

- Future studies should develop multiple methods of assessing patient adherence, including self-report, behavioral observation and recording, and change in clinical indexes. Different types of interventions should be included and tested for effectiveness.

ACKNOWLEDGMENT

The work undertaken for this research was part of the first author's PhD studies, generously funded through the Saudi Cultural Bureau.

REFERENCES

1. Haynes RB. Introduction. In: Haynes RB, Taylor DW, Sackett DL, eds. *Compliance in Health Care*. Baltimore, MD: Johns Hopkins University Press; 1979:1–7.
2. Nowicki SJ, Strickland BR. A locus of control scale for children. *J Consult Clin Psychol*. 1973;40:148–154.
3. Asimakopoulou K, Daly B. Adherence in dental settings. *Dent Update*. 2009;36:626–630.
4. Brawley LR, Culos-Reed SN. Studying Adherence to therapeutic regimens: overview, theories, recommendations. *Control Clin Trials*. 2000;21(suppl 1):S156–S163.
5. Michie S, van Stralen MM, West R. The behavior change wheel: a new method for characterising and designing behavior change interventions. *Implement Sci*. 2011;6:42.
6. Michie S, West R. Behavior change theory and evidence: A presentation to government. *Health Psychol Rev*. 2012; 7(1):1–22.
7. Bishop P, Barlow J, Williams N, Hartley P. Reflections on a multidisciplinary approach to evaluation of patient-literature materials. *Health Educ J*. 1997;56:404–413.
8. Ley P. *Communicating with Patients*. London, UK: Chapman and Hall Press; 1988:172–179.
9. Lefer L, Pleasure MA, Rosenthal L. A psychiatric approach to the denture patient. *J Psychosom Res*. 1962;6:199–207.
10. Ley P, Spelman MS. *Communicating With the Patient*. London, UK: Staples Press; 1967:114–116.
11. Thickett E, Newton JT. Using written material to support recall of orthodontic information: a comparison of three methods. *Angle Orthod*. 2006;76:243–250.
12. Richter DD, Nanda RS, Sinha PK, Smith DW, Currier GF. Effect of behavior modification on patient compliance in orthodontics. *Angle Orthod*. 1998;68:123–132.
13. Feil PH, Grauer JS, Gadbury-Amyot CC, Kula K, McCunniff MD. Intentional use of the Hawthorne effect to improve oral hygiene compliance in orthodontic patients. *J Dent Educ*. 2002;66:1129–1135.
14. Parsons HM. Hawthorne: an early OBM experiment. *J Organ Behav Manage*. 1991;12(1):27–43.
15. Wright NS, Fleming PS, Sharma PK, Battagel J. Influence of supplemental written information on adolescent anxiety, motivation and compliance in early orthodontic treatment. *Angle Orthod*. 2010;80:329–335.
16. Acharya S, Goyal A, Utreja AK, Mohanty U. Effect of three different motivational techniques on oral hygiene and gingival health of patients undergoing multibracketed orthodontics. *Angle Orthod*. 2011;81:884–888.